BULLETIN

OF THE

MADRAS GOVERNMENT MUSEUM

EDITED BY THE SUPERINTENDENT

THE MOLLUSCA OF KRUSADAI ISLAND

(IN THE GULF OF MANAAR)

I.—AMPHINEURA AND GASTROPODA

BY

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(*Published—February 1952*)

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THE MOLLUSCA OF KRUSADAI ISLAND

(IN THE GULF OF MANAAR)

I.—AMPHINEURA AND GASTROPODA

By S. Thomas Satyamurti, M.A., F.Z.S.

At the time when the earliest published list of Krusadai Mollusca appeared in the *Bulletin of the Madras Government Museum, Natural History Section*, I, 1927, entitled "The Littoral Fauna of Krusadai Island" our collections of Molluscan specimens from Krusadai Island were limited, for a number of species that occur in and around the Island have not been recorded in the list. Since then, numerous additions have been made to the existing collections so as to make them sufficiently exhaustive. Further, with the acquisition of the late Mr. Crichton's shell collections which contain a number of Krusadai and Pamban forms, our material of Krusadai Mollusca has considerably increased, and the present paper has been prepared not only to record all those species of shells collected from the Pamban area, but also to present a comprehensive, descriptive report on the Mollusca of Krusadai Island, with the help of which field workers visiting the Island should be able to identify the specimens they collect.

Specimens of the species included in this paper have been collected not only from Krusadai Island itself, but also from the usual collecting grounds around it such as Pamban, Kundugal Point, Shingle Island and Pulli Reef. The specimens collected consist both of dead shells and of live animals ; among the latter the vast majority are provided with shells, but a few (the Nudibranchiata) have no shell and are entirely soft-bodied. The dead shells are mainly found washed up on the beach, while the live molluscs occur in various situations such as sheltered places under pieces of dead coral and shingle, in the crevices of stones and corals, in surface layers of mud on the shore line, on stems of bushes growing out into the sea which remain partly submerged during high tide and on the pillars and large blocks of stone underneath the Pamban bridge. Some bivalves (*e.g.*, *Donax*) burrow rapidly in the mud near the shore line, and may be collected in large numbers at certain places by digging up the mud with a shovel. The majority of the living Mollusca that have been collected are littoral forms, only a few, such as the tusk shells (*Dentalium*) being bottom living forms which have to be collected by means of a dredge. The Cephalopods (including the octopus and the cuttlefish) are active, free swimming forms which can be collected with the aid of a net. The snails and bivalves are on the whole sedentary, or sluggish and slow-moving animals, but a few such as the Pectinidae (scallops) and the Galeommidae have acquired the power of swimming, while a few others, such as the Janthinidae, or violet snails, are pelagic. All these families are represented at Krusadai.

The classification followed in this paper is in the main that of Thiele's "Handbuch der systematischen Weichtierkunde" (Jena, 1931) as this is the latest and most complete classification of the Mollusca at present available. But this classification is itself largely based on that adopted by Dr. Paul Pelseneer in his volume on Mollusca in "Lankester's Treatise on Zoology" which still remains one of the best standard descriptive works on Mollusca in English.

The Mollusca are broadly divided into five classes, namely, Amphineura, Gastropoda, Scaphopoda, Pelecypoda and Cephalopoda. It may be helpful to point out at the outset the distinguishing features of these classes.

In the Amphineura the body is elongated and symmetrical and there are numerous spicules embedded in the mantle Of the two orders into which this class is divided, only one, the Polyplacophora, characterised by the presence of eight shell pieces arranged in a linear series, are represented at Krusadai. In the Gastropoda the shell consists of only one piece, which is usually well developed and spirally coiled, but may be occasionally rudimentary or even absent altogether. In the Scaphopoda the shell is tubular and tusk-shaped. The Pelecypoda possess a bivalve shell, that is to say, the shell is composed of two pieces, or valves, right and left, hinged together at their apices or umbones. The Cephalopoda have a well developed head and a circle of processes or arms round the mouth ; a shell may be present or absent, and when present, may be external on internal The cuttlebone, a white, calcareous, elongated structure which is found frequently washed up on the beach, is the internal shell of the cuttlefish.

Each of these classes includes a large number of families many of which are represented in the Pamban area. In the following account the various species recorded are grouped under their respective families which in their turn are grouped under their respective classes and arranged in their systematic order. As the present account is mainly intended to help the amateur collector in identifying the specimens he collects, as a rule only the characters of the shell have been taken into consideration in describing the various species, these characters being generally very constant and of sufficient specific stability as to be fairly dependable aids to identification. However, in forms such as the Tectibranchs and the Nudibranchs, which have no shell at all, or at most have only imperfectly developed shells, the characteristics of the soft parts have been described.

The total number of species of Mollusca so far recorded from Krusadai Island and its neighbourhood is about 450, as against nearly 700 that have been reported from the Madras area. Comparing the recorded Molluscan fauna of Krusadai Island with that of the Madras area, one finds that there are many species which are common to both these localities while there are others which are exclusively confined to the one or the other. But the Pamban area appears to be far richer in reef-dwelling live Mollusca which are able to thrive very well there

owing to the presence of extensive reefs which remain partly exposed at low tide. On the other hand, the actual number of species recorded from the Madras area exceeds considerably the recorded number of Krusadai species, in spite of the substantial additions that we have been able to make to our existing collections of the latter. This difference in the number of recorded species of the two localities is possibly due to the intensive shell collections made at Madras by the late Mr. Crichton, and placed at the disposal of Dr. Gravely at the time when the latter was preparing his account of the " Shells and other Animal Remains of the Madras Beach " The present account is therefore not by any means a complete and exhaustive report on all the species of Mollusca which actually occur at Krusadai It is almost certain that further intensive collection in this locality might bring to light a number of species that have not yet been recorded from this area, but are still known to occur in the South Indian waters Many of the forms met with in the Pamban area are also recorded from Ceylon, particularly from the Galle coast, and also from Singapore and Philippine Islands ; these forms are generally known to be widely distributed in the Indo-Pacific region.

Many of the Krusadai species of Mollusca have been identified for us mostly by Mr. R Winckworth and our indebtedness to him has already been acknowledged in an introductory note prefixed to the previous list of Krusadai Mollusca published in the *Bulletin of the Madras Government Museum, Naturnl History Section*, I, No. 1, 1927. We are also deeply indebted to the late Mr. M. D. Crichton for his generous contributions to our shell collections And finally I must thank Dr. F. H. Gravely for the kind and valuable assistance and helpful advice he has given me in connexion with the preparation of this paper, Dr. A. Aiyappan for his constant guidance and unfailing interest in the work, Messrs. P. I. Chacko, P. K Jacob and M. Mukundan Unny, Research Assistants, Krusadai Biological Station, for all the facilities they have given me during my visits to the Island, and Sri S. Kanagasabai for preparing many of the illustrations

In preparing the keys to the various families, genera and species dealt with in this paper, the dichotomous system followed by Dr. Gravely in his paper entitled " Shells and other Animal Remains found on the Madras Beach " has been adopted.

Class AMPHINEURA.

Order Polyplacophora.

The Polyplacophora or Loricata, popularly referred to as chitons, are characterised by the presence of a flat, elongated foot with which they crawl slowly on the substratum, a distinct head and eight shell valves on the dorsal side surrounded by and embedded in a muscular girdle. The peripheral portions of these valves project into the substance of this girdle ; these portions are called *insertion plates*.

Three families are represented at Krusadai, and they may be distinguished with the aid of the following key :—

1. Shell valves as a rule with distinct lateral areas demarcated clearly from the central areas by conspicuous oblique ridge-like elevations ; upper surface of girdle covered with numerous closely packed scales	2
— Shell valves without such clearly demarcated lateral areas ; upper surface of shell valves usually coarsely granular, and their central portions longitudinally ridged ; girdle thick, very muscular, and covered on the upper surface with numerous shorter or longer bristle-like spines	CRYPTOPLACIDAE.
2. Animal usually broad and oval, shell plates transversely elongate, but antero-posteriorily short ; girdle narrow ; insertion plates with characteristic pectinated teeth . .	CHITONIDAE.
— Animal generally more elongated and vermiform ; shell plates relatively shorter transversely, but longer antero-posteriorly ; girdle broader ; insertion plates not pectinately crenated, but with distinct slits	ISCHNOCHITONIDAE.

Family CRYPTOPLACIDAE.

The upper surface of the shell valves is covered with coarse granules which as a rule merge into the longitudinal striae at the centre of the surface. The lateral areas are not clearly marked off from the median areas. There are five or three slits in the insertion plate at the front margin. The girdle is thick, very muscular and beset with numerous shorter or longer bristle-like spiny processes.

Two genera are represented, namely, *Craspedochiton* and *Acanthochitona.* The latter is readily distinguished from the former by the girdle being broader and by the presence of regular tufts of bristle-like spicules on the upper surface of the girdle.

Genus **Craspedochiton** Shuttleworth, 1853.

The girdle is moderately small above, short and peculiarly swollen beneath in front of the middle Its upper surface is covered with numerous short spines and its lower surface with minute, closely packed scales.

Only a single species has been recorded.

Craspedochiton laqueatus (Sowerby).

Plate I, fig. 1.

Chiton laqueatus, Sowerby, Proc. Zool. Soc. London, 1841, p. 104.
Chiton laqueatus, Reeve, Conch. Icon., IV, 1855, *Chiton*, pl xx., fig 135.
Craspedochiton laqueatus, Sykes, in Herdman, Ceylon Pearl Oyster, Fisheries Suppl. Report, I, 1903, p. 179.

The animal is broadly ovate, with moderately broad shell valves and a relatively narrow girdle, which, however, is considerably broadened anteriorly. The shell plates are feebly

keeled along their middle line and their central and lateral areas are not clearly differentiated. The sculpture consists of coarse granules developed more or less uniformly on either side of the median keel. The anterior terminal valve is faintly radiately ribbed in addition to the granulation. The posterior terminal valve is rather small, scarcely ribbed and not markedly raised in the middle. The girdle bears numerous close-set processes The margin of the ventral surface is slightly thickened forming a sort of veil all round. The shell valves of the single specimen in our collection are rather worn and appear to have lost their original colour; they are dull white, tinged faintly with green. Pamban.

Genus **Acanthochitona** Gray, 1821.

The shell is moderately small and elongated, the upper surface of the valves is granularly sculptured The insertion plates are small and bear two slits on their hind margin. The girdle bears bundles of spicules

The specimen referred to as *Acanthochitona sp.* in the previous list of Krusadai Mollusca [*Bull. Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 95] has been identified later by Mr. Winckworth as *Acanthochitona mahensis*, and is the only species of this genus recorded from the Pamban area.

Acanthochitona mahensis Winckworth

Plate I, fig. 2.

Acanthochitona mahensis, Winckworth, Proc Malac Soc, XVII, 1927, p. 207.
Compare fig of *Chiton fascicularis*, Reeve, Conch. Icon, IV, 1855, *Chiton*, pl x, fig. 53
Acanthochitona mahensis, Gravely, Bull Mad Govt. Mus. (Nat. Hist), V, No. 1, 1941, p. 24.

There is only a single Pamban specimen of this species in the Museum collection—a very small one labelled " Gulf of Manaar," but there are several large specimens collected by Dr Gravely from Chombala, near Mahe in the Malabar district, and these were also examined for purposes of comparison. The animal is moderately elongated and has a fairly broad and extensive girdle. The shell valves are smooth in the middle and not keeled as in the preceding species The lateral edges of the shell plates are deeply immersed in the girdle. The insertion plates are small but have well formed slits. The sculpture consists of numerous granules uniformly disposed, but the central areas are more or less smooth The upper surface of the girdle bears regular tufts of bristle-like spicules placed at equal intervals. These bristles are frequently lost in spirit-preserved specimens. The lower surface of the girdle is quite smooth. The shell plates are of a pale pinkish white colour. Gulf of Manaar.

Family ISCHNOCHITONIDAE.

The shell valves as a rule possess clearly demarcated lateral areas and are variously sculptured. The insertion plates of the anterior and posterior terminal valves bear well developed

slits in varying number, but those of the intermediate valves usually bear only one on either side, seldom more. The girdle is usually covered on the upper surface with a large number of fluted scales ; its lower surface is beset with very small, closely packed scales arranged in radiating rows.

A single genus, *Ischnochiton,* represented by four species has been recorded.

Genus **Ischnochiton** Gray, 1847.

The shell is generally furrowed or ribbed, but may sometimes be smooth. The scales of the girdle are very closely packed and overlapping and may either be smooth or fluted. The insertion plates are well slit The animal is ovate or elongated.

The four species may be distinguished as follows :—

1. Animal much elongated, narrow, moderately elevated, girdle relatively broad ; shell valves longitudinally ribbed, the ribs becoming finer towards the centre ... ... *I. herdmani.* (Sub-genus *Stenoplax*).
— Animal relatively less elongate, broader ; girdle relatively narrower ; the sculpture on the surface of the shell valves not as above, and at least partly granular .. .. 2 (Sub-genus *Ischnochiton s. str*).
2. Entire surface of the shell more or less uniformly sculptured with regular rhombic granulation . . *I. aequigranulatus.*
— Lateral and central areas of the shell valves sculptured differently 3
3. Lateral areas of the valves with raised radiating ribs, rest of the surface of the valves finely granular in the centre, and longitudinally ribbed on the pleural areas. *I. gallensis.*
— Lateral areas of the valves with radiating ridges, the ridges being broken up into rounded white nodules, the central areas uniformly and very minutely granulated ... ... *I. comptus.*

Ischnochiton herdmani Sykes.

Plate I, figs. 3*a* and 3*b*.

Ischnochiton herdmani, Sykes, in Herdman, Ceylon Pearl Oyster Fisheries Suppl. Report, I, 1903, p. 178, fig. 6.

This is one of the commonest chitons met with at Krusadai, and is easly recognised by its comparatively large size, long, narrow shape and broad girdle. The shell is narrow

and elongate. The anterior and posterior terminal valves are elegantly ribbed with close-set, concentric ridges, the edges of these ridges being coarse and somewhat interrupted. The lateral areas of the intermediate valves are longitudinally ridged, these ridges appearing as continuations of the concentric ones of the terminal valves. The anterior portion of the posterior valve and the median areas of the intermediate valves are traversed by elongated interrupted ridges which Herdman aptly compares to " marks made by a blunt dagger." Along the centre of the median areas these ridges become more elongate and much finer. The lateral areas are slightly raised and are demarcated from the central areas by oblique ridge-like elevations. The anterior and posterior terminal valves bear nine slits on their insertion plates, while those of the intervening valves carry only one slit. The girdle is broad and carries closely packed overlapping scales. The upper surface of the valves is pale pinkish brown, but the central portions are either paler or marked with rusty brown or greenish patches. The interior of the valves is whitish, slightly tinged with pink. Krusadai and Shingle Islands.

Ischnochiton gallensis von Knorre.

Ischnochiton gallensis, von Knorre, Jena Z. Naturwiss, LXI, 1925, p. 611.

A single small specimen of this species, identified by Mr Winckworth, is represented in the collection. The animal is broadly ovate, with a relatively narrow girdle and broad shell. The lateral areas of all the valves except the anterior terminal one bear three or four raised radiating ribs The rest of the surface is finely obliquely ridged on the pleural areas and minutely granulated in the centre ; this granulation in the middle appears to be formed by the close inter-crossing of the fine oblique ridges of either side in this area. The entire surface of the marginal areas of the terminal valves is faintly radiately ridged The anterior terminal valve, however, lacks the raised ribs characteristic of the lateral areas of the other valves. The girdle is covered by small, ovate, closely overlapping scales. The shell is brownish, irregularly marked with patches of white and pale brown. The overlapping edge of each valve is marked by dark spots. The girdle is banded alternately with pale and dark brown. Krusadai Island.

Ischnochiton aequigranulatus von Knorre.

Plate I, fig. 4.

Ischnochiton aequigranulatus, von Knorre, Jena Z. Naturwiss, LXI, 1925, p. 605.

This species is closely related to *I. bouryi* Depuis (=*I. variegatus* Nierstrasz) with which it was identified in the previous list of Krusadai Mollusca [*Bull. Mad Govt. Mus.* (*Nat. Hist.*), I. No. 1, 1927, p. 95]. The animal is considerably elongate, with broad shell valves and relatively narrow girdle The entire surface of the valves is more or less uniformly sculptured with a fine, regular, rhombic granulation. The scales on the surface of the girdle are much more minute than in the preceding species. The lower surface of the girdle is quite

smooth. The shell is pale green, whitish in the middle of the central areas and at the edges of the lateral areas. The upper surface of the girdle is traversed by broad, dark brown bands. Krusadai Island.

Ischnochiton comptus (Gould).

Plate I, fig 5

Chiton comptus, Gould, Proc. Boston Soc. N. H, VII, 1859, p. 163.
Ischnochiton comptus, Pilsbry, Man Conch., XIV, 1892, p 117
Ischnochiton comptus, Nierstrasz, Siboga-Expeditie, Chitonen, XLVIII, 1905, p 24, figs. 10, 77-85.

This species is represented in the Museum collection by a single small spirit-preserved specimen from Shingle Island The animal is moderately broad, oblong-ovate and somewhat flattened The girdle is fairly wide. The lateral areas of the valves are coarsely ribbed with radiating ridges which are cut up into whitish tubercles The entire surface of the central areas is sculptured with very minute, regular granulation, the extent of this granulation being considerably reduced in the posterior terminal valve and almost altogether replaced by coarse, interrupted ridges in the anterior terminal valve. The scales on the surface of the girdle are closely packed and somewhat longitudinally elongate. The valves are pale brown, with three distinct, white longitudinal bands in the centre of each valve, diverging anteriorly and separated by two narrow triangular patches of the ground colour. The girdle is whitish conspicuously banded with dark brown. Shingle Island.

Family CHITONIDAE.

The shell valves generally bear clearly demarcated lateral areas, sculptured or more rarely smooth The insertion plates are characteristically pectinately toothed. The girdle is covered with scales, elongated spines or small bristles.

Two genera, *Chiton* and *Tonicia*, are represented each by a single species. In the genus *Chiton* the girdle is beset with imbricating scales which have a superficial resemblance to those of *Ischnochiton* ; but in *Tonicia* the girdle has a smooth, matt appearance, being studded with microscopic bristle-like processes.

Genus **Chiton** Linné, 1758.

The shell is moderately large, with the central and lateral areas differently sculptured. The scales covering the girdle are often smooth, but may sometimes be minutely fluted.

Chiton maldivensis (Smith).

Ischnochiton maldivensis, Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, 1903, p. 619.

Mr. Winckworth has recorded in his notes on Krusadai chitons that a single specimen of this species has been collected at Pamban, but unfortunately this specimen is not now

available in the Museum collection, as it had probably been retained by him after identification. The shell valves in this species are characterised by a strongly marked sculpture of parallel grooves not reaching to the median line, and radial lines of granules on the lateral areas. Pamban.

Genus **Tonicia** Gray, 1847.

The shell valves are usually strongly sculptured and the summits of the intermediate valves are well raised. The girdle appears smooth to the naked eye, but is actually covered all over with microscopic setae.

Tonicia pectinoides Sykes.

Plate I, fig. 6.

Tonicia pectinoides, Sykes, in Herdman, Ceylon Pearl Oyster Fisheries Suppl. Report, I, 1903, p. 179, fig. 1.

The shell is ovate, moderately broad and surrounded by a very narrow girdle. The lateral areas of the shell valves are strongly elevated The sculpture consists of broad, strongly developed longitudinal ribs on the central areas of the intermediate valves and on the anterior portion of the posterior terminal valves, the interstices between these ridges being traversed by minute transverse riblets, and rows of flattened nodules on the lateral areas of the intermediate valves, on the entire surface of the anterior terminal valve and on the posterior portion of the posterior terminal valve. The nodules on the intermediate valves are fewer and more widely separated than those on the terminal valves. The insertion plates are provided with well developed slits. The single spirit-preserved specimen in the Museum collection is somewhat faded ; the shell is pale yellowish brown and the girdle tinged with green. Krusadai Island.

Class GASTROPODA.

This is a very large and important class of Mollusca including the snails, whelks, cowries, limpets, sea-hares and their allies. A shell is usually, but not invariably, present. When present, it consists of a single piece and is therefore said to be *univalve*. It is usually spirally coiled and the direction of the coiling is as a rule clockwise. The anatomy of the Gastropods is characterised by marked asymmetry in the adult state. The head, foot and the mantle can often be seen well extended outside the shell in the live state, especially when the animal is moving. The foot is a massive muscular organ, generally with a flattened, creeping sole, but may be variously modified according to the habit of the animal. The mantle is a thin slimy flap of integument forming the external covering of the body and secreting the shell. The head is well developed and forms a more or less cylindrical mass at the anterior end of the body, bearing one or two pairs of tentacles dorsally. For definitions of the various terms used in the description of the shell reference may be made to the *Bulletin of the Madras Government Musem, Natural History Section*, V, No. 2, 1942, entitled " Shells and other Animal Remains found on the Madras Beach," by Dr. F. H. Gravely.

The Gastropoda are broadly divided into two main groups, the Streptoneura and the Euthyneura ; the former are bisexual and have the nervous system thrown into a figure-of-eight, while the latter are hermaphrodite, in which the main nerve trunks have become secondarily straightened out and assumed a parallel condition. Each of these sub-classes is in its turn divided into two orders, the former into Aspidobranchia and Pectinibranchia, and the latter into Opisthobranchia and Pulmonata. The Aspidobranchia include the most primitive Gastropods in which the nervous system is only very slightly concentrated, while the Pectinibranchia include more advanced Gastropods with a more concentrated nervous system ; these two orders comprise the vast majority of marine shell-bearing Gastropods. The Opisthobranchia are also marine, but exhibit a marked tendency to the reduction of the shell which is either altogether wanting or at most only imperfectly developed and often internal. The Pulmonata include mainly land and freshwater Molluscs with adaptation to aerial respiration, either with or without a shell, though a few marine forms are also known.

As already pointed out by Dr. Gravely in his paper on Madras Shells, though the classification outlined above bears out the natural blood-relationship between the various groups, yet students and amateur field workers might find a more or less artificial key drawn up from easily distinguishable external characters, especially of the shell, far more helpful in assigning the specimens he collects to their respective families. When once the family of a particular specimen has been determined, the reader can readily turn to the account of that family in the descriptive part of this paper, where he will find further diagnostic keys for distinguishing the various genera and species included in the family, and will thus be able to finally arrive at the description of the relevant species.

It is therefore hoped that the following key, the greater part of which is based on the one drawn up by Dr. Gravely for Madras Shells, will be of help in placing the Krusadai specimens of the Gastropods in their respective families :—

1. Shell absent altogether[1] 56
— Shell present,[2] usually external and well developed, but sometimes reduced and internal 2
2. Shell uncoiled and consequently whorls irregularly separated ; shell often attached to coral rock or similar substratum ... ... VERMETIDAE, p. 74.

[1] In the family Pleurobranchidae, however, a small internal shell is present in certain genera, though it is totally absent in *Euselenops* (which alone is represented at Pamban) and in *Pleurobranchaea*, which is the only other genus of this family commonly represented on the South Indian shores. But the family as a whole may be readily distinguished by other diagnostic characters such as the soft, jelly-like consistency of the body and the presence of the single gill on the right side.

[2] In the genus *Bursatella* (Family Aplysiidae), however, the shell is entirely absent, the general tendency towards the reduction of the shell in the Aplysiidae reaching its climax in this genus ; but its other Aplysiid characters, such as the presence of parapodia readily enables one to distinguish it as a member of the Aplysiidae in spite of the total absence of the shell.

— Shell not irregularly uncoiled ; whorls when developed (as they usually are) compact ; shell never attached ... ... 3.

3. Shell always much reduced, more or less *internal*, often simple, flattened and plate-like ; spire usually rudimentary ; animal with large, well developed parapodia ; including the sea hares ... ... APLYSIIDAE, p. 220.

— Shell almost always well developed, *external*, and relatively much larger in proportion to the size of the body ; spire normally well developed, but occasionally concealed or depressed 4

4. Shell generally conical or cap-shaped with a rudimentary spire, which is often entirely absent ; aperture very large in proportion to size of shell ; *or*, shell flattened and aperture not defined 5

— Shell generally not of the above shape ; spire clearly developed and easily recognisable, though sometimes depressed to a varying degree and occasionally concealed completely within the body whorl ; aperture considerably smaller in proportion to size of shell, being very large only when shell is greatly flattened 10

5. Shell usually with a curved, half-horn-shaped internal appendage representing the indrawn spire ; shell as a rule somewhat irregularly shaped and crudely sculptured 6

— Shell without such internal accessory appendage ; shell as a rule more regularly shaped (though not always quite symmetrical) and more elegantly sculptured 7

6. A curved internal appendage present when the shell is conical or cap-shaped,[1] or a flat, plate-like appendage, more or less parallel to the shell present, when the latter is flattened [2] ; aperture when well defined rounded ; apex either central [1] or terminal [2] ; visceral mass spiral ... ... CALYPTRAEIDAE, p. 95.

[1] The genus *Crucibulum*, including the crucible shells.
[2] The genus *Crepidula*, including the slipper limpets

— A curved, corniform internal appendage always present (at least in the genus *Cheilea*, which alone is represented at Krusadai). Shell almost always hood-shaped or bowl-shaped ; apex situated somewhat behind the middle ; visceral mass conical ; embryonic shell spiral ... ... AMALTHEIDAE, p. 93.

7. Apex of shell very excentrically placed, close to the front margin, and more or less strongly curved forwards towards that margin ; shell white, finely and closely radiately grooved throughout ... ... PHENACOLEPADIDAE, p. 63.

—Apex of shell comparatively more centrally placed and normally pointed, not curved forwards ; shell usually marked with bright rays or other colour markings, and more strongly sculptured 8

8. Shell symmetrical and without any radial groove on the right side of the inner surface ; including the true Prosobranchiate limpets and key-hole limpets. 9

— Shell rendered markedly asymmetrical by the presence of a shallow radial channel on the right side of the inner surface ; including the "lung-limpets" of the group Pulmonata ... ... SIPHONARIIDAE, p. 251.

9. Margin of shell and mantle entire ; apex of shell not perforated by a hole ... ... PATELLIDAE, p. 35.

— Margin of shell with a more or less well developed slit or indentation or at least an internal line representing a slit, when margin of mantle is correspondingly split anteriorly ; or apex of shell perforated by a distinct hole, when apex of mantle is also correspondingly perforated ... ... FISSURELLIDAE, p. 29.

10. Spire much reduced, often depressed to such an extent as to be almost on the same level as the adjacent portion of the body whorl which is always greatly enlarged ; when spire is slightly raised above the level of the body whorl, the latter is usually inflated and globular, and aperture semi-circular 11

— Spire usually normally developed, not depressed, and though sometimes small, not on a level with the

adjacent portion of the body whorl, and always sharply raised above it, except when spire is completely concealed within the body whorl or has been invaginated into it, when its position is usually indicated externally by a slight depression or narrow pit respectively[1] 14

11\. Body whorl greatly flattened and aperture very large; lip of aperture and columellar area normal; operculum reduced or totally absent 13

— Body whorl not strongly flattened, more or less globular, ovoid or lenticular, and at most only moderately depressed; aperture comparatively reduced and generally semi-circular; outer lip either abnormally thickened or expanded and reflected at the edge 12

12\. Body whorl generally globular or obliquely rounded; columellar area wide and extensive, often tuberculated or irregularly ridged; outer lip abnormally thick; aperture reduced to a D-shaped opening, its straight side being bounded by the columellar edge; operculum present, generally calcareous and provided with an apophysis; shell without umbilicus; marine molluscs ... ... NERITIDAE, p. 54.

— Body whorl lenticular and discoidal or depressly globose; aperture very oblique and small; outer lip well expanded and reflected out; the inner terminations of this reflected part approaching and sometimes connected by a raised callus (especially in *Planispira*, which alone is represented at Pamban); shell generally umbilicated; fresh water or brackish water molluscs ... ... PLEURODONTIDAE., p. 254.

13\. Inner surface of shell with pearly lustre (which, however, is apt to be absent in worn shells); body whorl with a series of perforations near the margin allowing the exit of tentacle-like processes of the mantle during life ... ... HALIOTIDAE, p. 28.

[1] Shells such as cowries and melon shells should be regarded as belonging to this group, as in these cases the spire has been invaginated into, or concealed within, the body whorl.

— Inner surface of shell without pearly lustre ; body whorl without perforations near the margin ; operculum present, small and rostrate ... ... NATICIDAE, p. 104. (part).

14. Inner surface of shell with pearly lustre [1] 15

— Inner surface of shell without pearly lustre ... 16

15. Operculum chitinous ; body whorl as a rule not markedly enlarged ; usually a 'false umbilicus' [2] is developed ; occasionally umbilicus absent in the adult ... ... TROCHIDAE, p. 36.

— Operculum calcareous, body whorl almost always greatly enlarged and conspicuously larger than the whorls above [3] ; umbilicus, when developed normal. TURBINIDAE, p. 50.

16. Shell more or less in the form of a short, wide cone, with the base horizontally flattened ; width of base exceeding height of spire ; whorls of spire rapidly diminishing in diameter form below upwards ; outer walls of whorls flat, and those of successive whorls forming the straight sides of the cone-shaped shell ; body whorl not inflated, nor particularly enlarged ; aperture small and often oblique or almost horizontal. 17

— Shell not of the above shape, usually taller than broad ; base of shell generally narrower and more or less rounded, not horizontally flattened ; body whorl often enlarged or even inflated ; walls of the other whorls usually (but not invariably) rounded and bulging ; aperture relatively larger in proportion to the size of the shell and not obliquely compressed. 18

17. Umbilicus very large and leading into a wide, but gradually diminishing cavity extending throughout the entire length of the columella ; surface of shell rather neatly sculptured and brightly coloured ... ARCHITECTONIDAE, p. 71.

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[1] This pearly lustre is absent in bleached shells and even in fresh ones of *Umbonium vestiarium*. The latter is a small flattened shell with a smooth, polished surface and ornamented with a rich variety of colour patterns. With regard to bleached shells it may be mentioned that shells of this group are generally conical in shape, or have the body whorl markedly transversely expanded and somewhat antero-posteriorly compressed.

[2] A 'false umbilicus' is one which surrounds, but does not enter, the columella, with the result that the latter appears to emerge *from* the umbilicus, instead of being *pierced* by it.

[3] In the sub-family Phasianellinae, the body whorl is not particularly enlarged, and the spire is considerably more elevated than is normal in the Turbinidae.

— Columella normal and umbilicus often closed ; surface of shell dull-coloured, rather coarse-looking, and usually with small stones, shells and other foreign matter cemented to it ... ... XENOPHORIDAE, p. 97.

18. Spire more or less completely concealed within or invaginated into the body whorl ; surface of shell almost always smooth and polished 19

— Spire fully exposed and distinctly protruding beyond the level of the body whorl, and though sometimes short, never enveloped by the body whorl ; surface of shell usually variously sculptured ; rarely smooth and glossy 23

19. Anterior canal entirely absent ; shell not very thick ; ovoid, with markedly inflated body whorl ; aperture wide anteriorly, but considerably narrowed posteriorly ; columella entirely devoid of folds ... 20

— Anterior canal definitely present, though sometimes somewhat ill defined ; shell thicker, more or less elongate ; aperture narrow throughout and in the form of a more or less elongated slit ; columella generally with distinct folds or teeth 22

20. Shell slightly thick and hard, and of a characteristic speckled or mottled brownish colouration ... ... BULLIDAE, p. 218.

— Shell much thinner and fragile, mostly whitish and with or without coloured spiral bands 21

21. Shell moderately large, white, with conspicuous, widely separated, brightly coloured spiral bands encircling the enlarged body whorl ... ... HYDATINIDAE, p. 217.

— Shell much smaller, uniformly translucent whitish or pale greenish white, and without characteristic coloured spiral bands as above ... . ATYIDAE, p. 219.

22. Shell usually small, with anterior canal only indistinctly developed and represented by a marginal notch ; outer lip not much thickened, smooth and devoid of teeth ... ... MARGINELLIDAE, p. 199.

— Shell generally larger ; anterior canal distinctly developed as a deep cleft ; outer lip of aperture greatly thickened and often strongly toothed ; shell usually more brightly coloured ... ... CYPRAEIDAE, p. 113.

23. Spire tall, with numerous whorls ; body whorl and whorls of spire forming a contiguous, more or less uniform series with respect to size, gradually diminishing in size from below upwards ; body whorl not markedly more enlarged than whorls of spire ; walls of whorls either flat or bulging 24

— Spire shorter, or if somewhat elevated, with relatively much fewer whorls ; body whorl somewhat markedly enlarged in proportion to whorls of spire ; whorls usually bulging outwards about their middle to a varying degree 31

24. Spire very long and slender, with numerous whorls ; transpiral sculpture often present ; surface often with a slight gloss ... ... TEREBRIDAE, p. 214.

— Spire relatively broader in proportion to height of shell ; whorls less numerous and often considerably wider ; spiral sculpture predominating ; surface often duller 25

25. Shell generally minute ; sculpture rather variable, usually finely granular 26

— Shell very much larger, at least with distinct spiral sculpture in the form of grooves or ridges, either on the entire surface or confined to portions of it ; transpiral sculpture in the form of grooves sometimes present in addition to spiral sculpture 27

26. Shell sinistral ; aperture with distinct anterior canal ... ... TRIPHORIDAE, p. 89.

— Shell dextral ; anterior canal absent, but front part of lip usually with a hollow ... ... RISSOIDAE, p. 68.

27. Shell small or moderate-sized, elongately ovate, rather thin, smooth or with variable sculpture, frequently ridged, striate, costulate or spinuously

nodulate and covered with a blackish brown periostracum. Aperture ovate and generally entire ; fresh water . ... MELANIIDAE, p. 78.

— Shell thicker and often larger, either smooth or with sculpture, generally consisting of spiral ridges or rows of tubercles ; as a rule without characteristic blackish brown periostracum ; aperture either rounded and entire or narrowly ovate and canaliculate ; marine 28

28. Anterior canal totally absent ; whorls somewhat distinctly bulging outwards in the middle, and the sutural constrictions between the several whorls deep and well marked ; shell as a rule lightly coloured, usually pale yellowish brown ; aperture rounded ... TURRITELLIDAE, p. 70.

— Anterior canal present, whorls less conspicuously bulged in the middle and the sutural constrictions between the several whorls less deep ; surface of shell generally of a darker colour, often of a dark purplish brown tint when fresh [1] ; aperture narrowly ovate 29

29. Surface of shell rather glossy ; middle portions of the whorls, at least of the lowermost ones, smooth ; rest of the surface with fine sculpture consisting of elegant spiral grooves decussating with feebly-developed, close-set transpiral ridges ; callus on columella inconspicuous ... ... NASSIDAE, p. 178. (part [2]).

— Surface of shell not glossy, often dull ; whorls more or less strongly sculptured throughout their surface ; sculpture on the whole more coarse-looking and often strongly tuberculated ; callus on columella distinctly developed as a thin whitish sheet. 30

30. Anterior canal bounded on the outside by a broad, flattened, angular process of the outer lip. A distinct, obtuse, transpiral ridge-like elevation (not a sharply developed crest) often present on the body whorl on

[1] Bleached shells naturally do not have this colour.

[2] The genus *Bullia*.

the side opposite to the aperture ; operculum with the nucleus situated centrally ... . POTAMIDIDAE, p. 80.

— Anterior canal not bounded on the outside by any flat, angular process of the outer lip ; no specially developed transpiral elevation present on the body whorl opposite to the aperture, unless it be one of the transpiral crests, which, when developed, are present on the other whorls as well ; operculum with the nucleus situated excentrically .. ... CERITHIIDAE, p. 82.

31. Shell thin, rather fragile, generally of a deep bluish violet colour, with rounded aperture and thin outer lip, the edge of which tends to break easily ; pelagic snails with a froth-like float (which may often be seen attached to the shells freshly washed up on the beach) JANTHINIDAE, p. 91.

— Shell thicker, often greatly so ; colour not as above, variable ; aperture sometimes rounded, but more usually ovate or elongate ; outer lip thicker ; not pelagic and devoid of a float 32

32. Shell globular or ovoid, with very short, almost depressed spire and markedly inflated body whorl ; umbilicus present, sometimes partially or completely filled with callus 33

— Shell not as above, generally more elongate 34

33. Shell with open umbilicus, small, smooth protoconch and larger, rounded, inflated body whorl ; colourless, with spiral ribs and more or less stout, oblique transpiral ridges forming a more or less strongly latticed sculpture ... ... VANIKORIDAE, p. 92.

— Shell with umbilicus usually reduced to a crescent-shaped aperture by the entry of a columellar callosity from the columellar border, or even completely filled up by callus deposit ; shell smooth and sometimes polished and glossy, never with pronounced ridges or ribs .. .. NATICIDAE, p. 104. (part).

34. Anterior canal entirely absent ; shell somewhat thin and outer lip of aperture thin ; spire considerably elevated and apex of spire sharply pointed ; umbilicus

never present ; sculpture, when present, consisting of uniform spiral grooving only ... ... LITTORINIDAE, p. 64.

— Anterior canal present, either as a distinct groove bounded by ridges or folds, or as a slightly excavated cavity terminating a little away from the general outline of the aperture, or at least represented by a distinct sinuate notch at the lower end of the aperture ; sculpture, when present, usually stronger, variable and often consisting of raised ridges or tubercles ; spire relatively shorter in proportion to the body whorl, but when anterior canal is greatly elongated, spire generally proportionately elongate 35

35. Aperture very large, more or less broadly rounded, usually broader in front than behind ; body whorl generally large and markedly inflated 43

— Aperture relatively smaller, usually narrow and more or less definitely elongate ; when rounded or ovate, rather small in proportion to the size of the shell ; body whorl, though often large in proportion to spire, not globularly inflated, but often considerably elongate instead 36

36. Well developed varices present as thick, strongly raised, transpiral ridges or crests on various radii on the surface of the whorls, indicating the close of successive growth periods, these varices being often closely transversely ridged or foliaceous, or even represented by rows of shorter or longer spines ... 52

— Varices usually absent, or at most inconspicuous and so feebly developed as to be scarcely recognizable 37

37. Spire shorter than height of body whorl, often very markedly so, its whorls being usually very much compressed ; aperture often narrow, linear, elongated and almost parallel-sided ; or, when anterior canal is slightly elongate, aperture narrowly ovate ... 38

— Spire normally developed, being about as high as body whorl (or, occasionally even higher), and its

whorls not appreciably compressed ; aperture normal, never greatly elongate 45

38. Shell thick, ovoid, with a large, greatly elongated, somewhat barrel-shaped body whorl ; spire short, with sharp, conically pointed apex ; surface of shell smooth and highly polished, and often brightly coloured, though rarely whitish ; columella with pronounced development of callus, especially in the posterior part ; anterior canal represented by a broad, sinuate notch at the lower end of the aperture ... OLIVIDAE, p. 188.

— Shell not of the above description 39

39. Body whorl generally shaped almost exactly like an inverted cone, large ; outer lip running rather close and parallel to the columellar border, reducing the aperture to a narrow, straight-sided, elongated slit ... CONIDAE [1], p. 201.

— Body whorl not shaped like an inverted cone, though often narrow and tapering below ; outer lip of aperture not parallel to the columellar border ; aperture usually a little broader, and, though still elongate, not strictly in the form of a narrow, straight-sided slit 40

40. Outer lip usually greatly thickened and everted into a prominent wing-like expansion which may sometimes be drawn out into long processes ; lower portion of this expanded outer lip usually much narrower than the upper part and often slightly, but distinctly, sinuate near its anterior termination ; spire often immersed partly in a posterior extension of this wing-like outer lip ... ... STROMBIDAE [2], p. 98.

— Shell not of the above description ; outer lip not thus expanded 41

41. Shell pear-shaped ; base of shell somewhat markedly narrowed and slightly drawn out, the

[1] In certain species, such as *C geographus* and *C nussatella*, the body whorl is somewhat inflated and not typically cone-shaped, and the apertural lips are not strictly parallel to each other.

[2] The markedly laterally compressed, arched foot (terminated by a horny appendage representing the operculum) present in the members of this family is a highly characteristic feature which enables one to distinguish a living specimen of this family very readily. In young shells the outer lip is scarcely thickened and expanded.

anterior canal being correspondingly produced as a short, channel-like groove; whorls usually shouldered, shoulder with row of nodules or tubercles (which, however, may sometimes be indistinct); outer lip not thickened or toothed 42

— Shell more ovoid, inflated, anterior canal united with the umbilicus and strongly twisted upwards and away from the aperture; aperture elongated, usually linear, sometimes broader in front than behind and its inner border usually irregularly plaited, outer lip often greatly thickened and sharply reflected out, its inner edge being generally strongly toothed CASSIDIDAE, p. 134.

42. Tubercles on shoulders of whorls prominent and strongly developed; columella without folds; shell as a rule without conspicuous horny covering ... VOLEMIDAE, p. 177.

— Tubercles on shoulders much less pronounced, often very indistinctly developed; columella with strong, spiral folds; shell as a rule with a thick, tenaceous, horny periostracum covering the surface[1] ... ... VASIDAE, p. 195.

43. Shell somewhat thin, very strongly and globularly inflated, and ornamented with rather widely set spiral ridges, or close-set spiral grooves . ... TONNIDAE, p. 145.

— Shell thicker and relatively less strongly or often more elongately inflated, and either smooth or with transpiral sculpture only; surface of shell usually somewhat glossy 44

44. Shell usually smooth, sometimes with feebly developed row of transpirally elongated nodules near the upper end of the whorls; spire sometimes sunk into the body whorl when aperture is unusually large; columella with distinct, obliquely spiral folds ... VOLUTIDAE, p. 197.

— Shell glossy, but with very strong, regularly spaced, raised transpiral ribs with flattened surfaces, and fine, closely set, transpiral ridges or striae in the wide interstices between these ribs; columella

[1] This horny covering is naturally lost in worn and bleached shells.

without folds, smooth, highly polished and strongly callous ... ... HARPIDAE, p. 196.

45. Shell more or less definitely spindle-shaped, gradually, but distinctly tapering both above and below, the base of the body wherl being almost always narrowed so as to approach the tapering spire in shape and appearance ; shell most wide at about the middle ; aperture narrow, rarely broad and ovate 46

— Shell definitely not spindle-shaped ; base of shell not tapering in the same manner as the spire, usually broadly rounded, and, though sometimes a little narrow, not tapered to such an extent as to approach the tapering spire in shape and appearance ; shell most wide just a little above the base ; aperture rounded and often broader above than below ... 51

46. Upper part of outer margin of aperture notched or hollowed, often distinctly and even deeply, but sometimes almost imperceptibly ; anterior canal elongate, but often somewhat shorter than the spire which is more or less slender, the broadest part of the shell being therefore usually below the middle ... ... TURR

— Outer lip of aperture entire and without a slit or excavation at the upper part of its margin ; anterior canal, when elongate, as long as the spire, which is not very slender and moderately broad at the base ... 47

47. Both spire and anterior canal considerably elongated, the latter being usually in the form of a spout-like projection ; aperture small in proportion to the size of the shell and somewhat ovately rounded ... ... FASCIOLARIIDAE, p. 185.

— Anterior canal not elongate ; or, spire considerably elongated 48

48. Aperture more or less narrow, linear and parallel-sided ; shell typically spindle-shaped, the base being very gradually narrowed 49

— Aperture slightly broader, somewhat elongately ovate, sometimes reduced in size owing to great thickening

of its lips; shell usually with prominent ridges or tubercles 50

49. Operculum absent; spiral sculpture usually predominating; spire fairly high; columella with folds which are more elongated posteriorly; inside of outer lip of aperture smooth . .. . MITRIDAE, p. 194.

— Operculum present, chitinous; transpiral ridges sometimes present in addition to fine spiral grooves; shell small, with relatively short spire; columella without folds; inside of outer lip of aperture often toothed ... ... PYRENIDAE, p. 167.

50 Surface of shell rather coarse-looking, often crudely ridged or tuberculated; lines of growth conspicuous and forming closely arranged, ridge-like folds which give the surface a coarse and roughened appearance; margins of aperture generally violet or deep purplish .. .. MURICIDAE [1], p. 149. (part).

— Surface not particularly coarse-looking; lines of growth not forming close-set folds; sculpture, when present, usually more elegant and often consisting of close-set spiral grooves or ridges only; a distinct periostracum usually present and frequently hairy . .. . BUCCINIDAE, p. 173. (part).

51. Surface of shell smooth, or even glossy, usually with a bright colour pattern of yellowish brown patches on a white ground; shell moderately large ... BUCCINIDAE, p. 173. (part).

— Surface of shell sculptured, less glossy, sometimes not at all so; colour and pattern of colouration not as above, varied; shell generally small 52

52. Shell rather thin, always higher than broad; aperture somewhat long and narrow and rather strongly narrowed above; columellar lip usually with one or two folds; surface as a rule with finely impressed

[1] The sub-family *Purpurinae*; it includes shells popularly called 'purples'; the genus *Jopas*, however, is an exception, as the surface of the shell is fine and even, neatly sculptured with a uniform, delicate spiral grooving, instead of being rough and coarse-looking as stated in this definition. In *Thais rudolphi*, which is a much commoner species, the surface of the shell, though somewhat coarse-looking, is devoid of rough ridges or tubercles.

spiral lines ; shell usually somewhat tapered at both ends so as to be more or less spindle-shaped ... ACTEONIDAE, p. 216.

— Shell thicker, sometimes very thick ; aperture more broadly ovate and less sharply narrowed above ; columella callous to a greater or less extent, but without folds ; surface with stronger sculpture, consisting either of spiral grooves or well developed ridges ; shell not markedly tapering below ... 53

53. Shell with close-set spiral grooves developed more or less uniformly throughout the surface ; shell generally very dark-coloured with white oblique streaks ; a prominent white ridge extending inwards from the inner side of the posterior end of the columellar border of aperture ; edge of operculum even PLANAXIDAE, p. 79.

— Shell sculptured not as above, usually with transpiral sculpture predominating and in the form of well developed ridges at least on portions of the surface ; columella generally more extensively callous ; ridge at posterior end of columellar border absent ; surface of shell usually somewhat glossy ; edge of operculum often serrated ... ... NASSIDAE, p. 178. (part).

54. Posterior canal very distinctly developed as a short, but deeply excavated groove at the posterior end of the aperture ... ... BURSIDAE, p. 141.

— Posterior canal entirely absent 55

55. Aperture generally elongately ovate, varices smooth or ornamented with thick, transverse ridges or nodules ; columella almost always with well developed folds or wrinkles ... . CYMATIIDAE, p. 138.

— Aperture more rounded, almost circular ; varices usually prolonged into long spines or thick-set foliaceous processes or in the form of closely frilled ridges. Anterior canal occasionally greatly elongated and bearing spines ; columella generally smooth and without folds ... ... MURICIDAE, p. 149. (part).

56. A single ctenidium present on the right side occupying the space between the foot and the mantle ;

anterior tentacles fused to form a frontal veil produced into two lateral lobes ; animal whitish, sometimes spotted, and usually of a jelly-like translucent appearance ... ... PLEUROBRANCHIDAE [1], p. 230.

— Ctenidium absent ; instead accessory respiratory structures usually developed in the form of secondary branchiae ; tentacles not fused so as to form a veil ; animal generally darker and more brightly coloured 57

57. Dorsal integument of the body very tough, leathery, and its surface beset with numerous hard, warty protuberances which have a tufted appearance ; plumose appendages aggregated in the form of secondary branchiae, or small, close-set, club-shaped papillae absent on the dorsal surface ; the mantle, however, bears small " eyes " scattered on its surface. ONCHIDIIDAE, p. 252.

— Animal with much softer dorsal integument ; dorsal surface without warty tubercles , accessory respiratory structures often developed in the form of secondary branchiae which are usually aggregated to form a circlet, or in the form of club-shaped dorsal papillae, or even in the form of strong longitudinal folds of the dorsal integument .. 58

58. Dorsal surface of mantle without any definite, projecting appendages, but often strongly longitudinally plaited ; a number of close-set branchial lamellae present along the sides of the foot beneath the mantle border ; anterior tentacles coalesced to form a shield with short lateral lobes ... ... ARMINIDAE, p. 244.

— Dorsal surface of mantle generally with branched appendages, their distribution on the surface being

[1] Thiele's classification of the Opisthobranchia is somewhat elaborate and differs considerably from that of Pelseneer ; it may therefore be helpful to point out certain of the differences, particularly those which relate to the families dealt with in this paper. The family Pleurobranchidae is placed by Pelseneer in the tribe Pleurobranchomorpha under the Tectibranchia, but is included by Thiele under the first sub-order, Notaspidea of the order Acoela, and the families Polybranchiidae (=Phyllobranchidae) and Elysiidae, while treated as members of the order Nudibranchia by Pelseneer, are entirely removed by Thiele from the Nudibranch group (which he treats as the second sub-order of the order Acoela) and placed in a different order, the Sacoglossa.

variable ; branchial lamellae under the mantle border absent ; anterior tentacles not modified as above 59

59. Secondary branchiae developed in the form of a distinct circlet of branched, plume-shaped appendages surrounding the anus, situated on the middle line in the posterior half of the surface ; additional pallial appendages usually, but not invariably, absent ; hind end of body usually rounded, not narrow and pointed. 66

— Secondary branchiae in the form of branched plumes surrounding the anus absent ; but accessory respiratory structures developed instead, in the form of small, dorsal papillae or large, ramified appendages arranged in longitudinal rows, or both ; hind end of body usually, but not invariably, narrow and more or less pointed 60

60. Two pairs of tentacles (an anterior and posterior cephalic) present ; dorsal surface closely beset with minute papillae and large, regularly spaced pairs of branched, tuft-like appendages 62

— Tentacles never more than one pair ; large, tufted and branched appendages absent ; but simple, small or moderate-sized dorsal papillae present on the dorsal surface 61

61. Foot broad, dorsal papillae large, flattened and developed in the form of foliaceous, deciduous cerata ; body more or less ovate and devoid of lateral expansions .. .. POLYBRANCHIIDAE [1], p. 227.

— Foot narrow, dorsal papillae small, simple ; body elongated, usually narrow and pointed behind, flattened and leaf-like, and provided with lateral expansions ... ... ELYSIIDAE [1], p. 229.

62. Anterior tentacles forming a distinct frontal veil which is usually beset with papillae at the margin ; body somewhat dorso-ventrally compressed ; ramified

[1] See foot-note on p. 25.

appendages not very large in proportion to the size of the body ... ... TRITONIIDAE, p. 233.

— Anterior tentacles free, distinct from one another and not forming a frontal veil ; body usually small, slender and elongated ; ramified appendages generally large in proportion to the size of the body 63

63. Rhinophores (i.e., the second pair of tentacles) surrounded by sheaths which may either be simple or branched at their free extremities 64

— Rhinophores without sheaths and consequently exposed throughout their entire length 65

64. Body strongly laterally compressed and elongated ; foot narrow ; front margin without the short anterior tentacles, but in their place there are two groups of small cylindrical or conical appendages mounted on a short peduncle ; rhinophores large, with long stalks and surrounded by a long sheath which is branched into two or three conical processes at its free end. Papillae on dorsal surface of mantle usually congregated into wart-like groups ... ... BORNELLIDAE, p. 246.

— Body not laterally compressed and elongated, more or less flattened ; foot relatively broader, though small, rounded in front ; anterior tentacles present, simple, not as above ; rhinophores with short, funnel-shaped sheaths surrounding their bases only, their terminal portions being fully exposed ; rhinophores simple, not laminated ... ... HANCOCKIIDAE, p. 247.

65. Body with more or less numerous, unbranched papillae all over the dorsal surface ; body not laterally compressed ; dorsal ramified appendages club-shaped and distinctly separated ; rhinophores usually with distinct, ring-shaped lamellae ... ... FLABELLINIDAE, p. 248.

— Body without small dorsal papillae, the intervening spaces on the dorsal surface between the rows of ramified appendages being smooth ; dorsal appendages in two or more rows, more profusely branched

into numerous, conically pointed processes, those of successive appendages in the same row being somewhat closely crowded together and not separated by distinct interspaces; rhinophores simple, not lamellated ... ... TERGIPEDIDAE, p. 249.

66. Mantle with spicules; oral tentacles variously developed or occasionally wanting; mouth with a conspicuous, denticulated, prehensile radula and occasionally with a collar ... ... DORIDIDAE [1], p. 234.

— Mantle without spicules; oral tentacles absent; mouth suctorial, opening on the front margin of the foot, without radula, jaws or collar, but with a retractile tube or proboscis .. .. DENDRODORIDIDAE [2], p. 242.

Sub-Class PROSOBRANCHIA.

Order Archaeogastropoda.

SERIES ZEUGOBRANCHIA.

Family HALIOTIDAE.

The shell is pearly within and markedly flattened with a greatly depressed spire; the body whorl and aperture are very large. The margin of the body whorl is perforated by a series of circular openings through which sensory processes of the mantle project during life. The foot is broad, ovate, and without an operculum. Members of this family are popularly called ear-shells.

This family includes only one genus *Haliotis*, which is represented at Krusadai by a single species, *H. varia*.

[1] This family is further subdivided into sub-families, a key to which is given later, in the descriptive account of the family.

[2] The family Doridopsidae was created by Alder and Hancock for the reception of the new genus *Doridopsis* Alder and Hancock, a synonym of *Dendrodoris* Ehrenberg, and Thiele has included it in the sub-family Dendrodoridinae under the large family Dorididae. Though Thiele's classification has been in the main adopted, especially in respect to the Nudibranchs, yet it has been considered desirable to follow Alder and Hancock in including *Dendrodoris* and its allies in a separate family, the Doridopsidae, in view of the great anatomical and physiological differences between the members of this group and the rest of the Dorididae, so vividly described by them in their 'Monograph on Indian Nudibranchiate Mollusca', (*Trans. Zool. Soc. London*, V, p. 124.)

Genus **Haliotis** Linné, 1758.

The characters are the same as those of the family.

Haliotis varia Linné.

Plate I, figs. 7*a* and 7*b*.

Haliotis varia, Linné, Syst Nat, Ed. X, 1758, p 780.
Haliotis varia, Reeve, Conch Icon, III, 1846, *Haliotis*, pl. 1, fig. 4.
Haliotis viridis, ibid., pl xiii, fig 40
Haliotis semistriata, ibid., pl xiv, fig 51
Haliotis varia, Hornell, Common Molluscs of South India, Mad. Fish. Bull, XIV, 1921, p. 103.
Haliotis varia, Gravely, Bull Mad Govt. Mus (Nat Hist.), V, No 2, 1942, p. 13.

Specimens of this species are moderately common in the Pamban area, and are usually found attached by their broad flattened foot to pieces of stone and dead coral on the reefs at Krusadai and Shingle Islands. The shell is moderately large, thick, with a broadly ovate profile. The outer surface of the shell is somewhat coarse-looking and is traversed by a few oblique rows of indistinct nodules, while the inner surface is smooth and beautifully pearly. The holes near the margin of the body whorl are usually four or five in number. The border of the mantle has a deep longitudinal slit over the rectum allowing a rapid expulsion of the respiratory current of water and of the excreta. The edges of this slit are incompletely fused together leaving a series of openings which correspond in number and position to the holes in the shell. Dr Thurston has recorded both *H. varia* and *H. semistriata* from Pamban, but Mr. Winckworth observes that the two forms are not sufficiently distinct to be separated The shell is dull greyish brown, often tinged with green; Pamban, Krusadai and Shingle Islands.

Family FISSURELLIDAE.

The shell is porcellanous, almost always symmetrical, either cap- or bowl- or shield-shaped, longer than broad, and as a rule with fine or latticed sculpture. There is either a hole at the apex or a slit at the front margin of the shell ; when a slit is present, it may be either deep and well defined, or reduced to a mere rudimentary notch. An operculum is absent. These molluscs are popularly called key-hole limpets.

Three genera are represented ; they may be distinguished as follows :—

1. Apex of shell perforated by a distinct hole, which may be elongate, ovate or more or less circular .. ... *Diodora*.

— Apex of shell imperforate ; a notch or slit present along the median line on the anterior margin of the shell, or at least that of the mantle and indicated on the inner surface of the shell by a line in the corresponding position ... ... 2.

2. Slit on front margin of shell deep and well defined. *Emarginula.*

— Slit on front margin of shell much reduced and represented only by a shallow notch ; mantle split anteriorly and partly reflected over the shell ... *Scutus.*

Genus **Diodora** Gray, 1821.

(Syn. **Glyphis** Carpenter, 1857).

The shell is conical with an ovate aperture ; the hole at the apex is either small or moderately large and situated somewhat in front of the middle. The outer surface of the shell is sculptured with finer or stronger radial ribs and usually also with concentric plaits.

As the name *Fissurella* is used for the South American key-hole limpets, the Indian forms have been grouped together under a separate generic name, viz., *Diodora,* of which *Glyphis* is a synonym.

Five species have been recorded ; they may be recognised as follows :—

1. Shell with several widely separated, specially strong ribs radiating from the centre, with weaker ribs in the interstices ; outline of shell more or less polygonal, the angles being marked by the points of termination of the strongly developed radial ribs ... ... *D. funiculata.*

— Shell without such specially marked ribs ; radiating ribs more uniformly developed and close-set ; outline of shell more evenly rounded 2

2. Shell with apex much elevated ; radial ribs of the latticed sculpture strong and rendered conspicuously nodular by the decussating concentric ridges ; margin of the shell toothed, the teeth occurring in pairs ... *D. clathrata.*

— Shell with apex relatively less elevated ; radial ribs not conspicuously raised into nodular swellings by the decussating concentric ridges ; apical hole usually oblong or ovate ; margin of shell not toothed as above 3

3. Shell narrow and elongate with the lateral margins almost parallel to one another ; radial ribs uniformly strong in front, and alternately strong and weak behind, all connected by concentric ridges so as to form a network ; radial ribs on the whole markedly

stronger than concentric ridges ; apical hole narrow and elongate, more or less rectangular ... ... *D. ticaonica.*

—Shell proportionately shorter and broader ; radial ribs more or less uniformly strong, but less markedly stronger than the concentric ridges, except sometimes in the posterior part of the surface where the radial ribs may be somewhat pronounced ; apical hole broader, less elongate and generally ovate 4

4. Shell moderately elevated ; outer surface of shell with a well marked colour pattern of alternating light and dark sectors ; outline of shell more or less broadly ovate ; sculpture simple ... ... *D. lima.*

— Shell much flatter ; outer surface of shell not coloured as above ; outline of shell more elongately ovate ; sculpture more elaborate, with a very fine network of secondary ribs in between the radial ribs in addition to the usual lattice . . .. *D. bombayana.*

Diodora funiculata (Reeve).

Plate I, fig. 8.

Fissurella funiculata, Reeve, Conch. Icon., VI, 1850, *Fissurella*, pl. ix, fig. 65.
Fissurella octogona, Reeve, ibid , pl xvi, fig 116
Fissurella imbricata, Sowerby, Thes. Conchyl., III, 1862, p. 194.

The shell is moderately elongate, distinctly narrower in front than behind, with a fairly well elevated apex which is placed nearer to the front margin than to the hind one. The apical hole is small in proportion to the size of the shell and slopes forwards from the apex, being narrower in front than behind. The surface of the shell is strongly sculptured with several strong radiating ribs, and weaker ones in the interstices ; these ribs as well as the interspaces between them are traversed by finer concentric ridges which give the radial ribs the appearance of rows of indistinctly separated nodules. The outline of the shell is somewhat polygonal, but if the margin is worn, it may appear more or less evenly rounded. The outer surface is pale brown, marked with widely separated pairs of dark brownish lines radiating from the apex. The inner surface is smooth, whitish and glossy, but its marginal portion is slightly wrinkled in correspondence with the position of the external ribs. Krusadai Island.

Diodora lima (Sowerby).

Plate I, fig. 9.

Fissurella lima, Sowerby, Thes. Conchyl., III, 1862, p. 198.
Diodora lima, Crichton, Journ Bomb Nat. Hist Soc, XLII, 1941, p. 337.
Diodora lima, Gravely, Bull. Mad Govt Mus. (Nat. Hist), V, No. 2, 1942, p. 13.

The shell is moderately broad, elevated, ovate and slightly narrower in front than behind. The sculpture consists of more or less uniformly strong, close-set radial ribs, decussated by concentric ridges, forming a lattice, the points where the concentric ridges cross the radial ribs being marked by nodule-like swellings on the latter. The intervening spaces of this network-like sculpture are represented by well sunk squarish pits. The outer surface of the shell is distinctly marked with alternating, unequal patches of white and dark brown radiating from the apex. The inner surface is whitish, smooth, but faintly toothed at the margin. The apical hole is proportionately less elongate than in the preceding species. Living specimens of this species are not uncommonly found attached to stones on the reefs and beneath the Pamban bridge. Krusadai Island and Pamban.

Diodora bombayana (Sowerby).

Plate I, fig. 10.

Fissurella bombayana, Sowerby, Thes. Conchyl., III, 1862, p 196
Glyphis bombayana, Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, 1906, p. 618.

The shell is flatter and more elongated than in the preceding species and is only very slightly narrower in front than behind. The sculpture is more elaborate ; it consists of (1) moderately strong radial ribs somewhat more widely spaced than those of the two preceding species, connected by equally widely spaced, though weaker, concentric ridges and forming the principal network with somewhat wide meshes, and (2) a much finer intermediate network in the interspaces between the main ridges, formed by the close reticulation of fine riblets in the meshes of the main network ; the median longitudinal riblet, however, is much the strongest of these minute intermediate riblets. The apical hole is broader and more rounded than in any of the other species of *Diodora* recorded from the Pamban area The shell is yellowish white, marked with interrupted radial patches of brown. Krusadai Island.

Diodora ticaonica (Reeve).

Plate I, fig. 11.

Fissurella ticaonica, Reeve, Conch. Icon, VI, 1851, *Fissurella*, pl. xiv, fig. 107.
Glyphis ticaonica, Pilsbry, Tryon's Man Conch., XII, 1891, p 225, pl. 20.
Glyphis ticaonica, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 86.

The shell is narrower and more elongated than in any of the preceding species. The apex is moderately elevated and is placed much nearer the front margin. The short area

of the surface in front of the apex is concave and slopes down steeply, while the more extensive area behind the apex inclines more gradually and is somewhat convex. The sculpture consists of a well marked lattice formed by the reticulation of strong narrow radial ribs and concentric ridges ; the radial ribs are often alternately stronger and weaker, but the weaker ones generally terminate before reaching the apex. The apical hole is narrow, elongate and oblong. The margin of the shell is slightly excavated in the middle at the sides. The shells in the collection are of a dull dirty-white colour, sparingly blotched with brown, but one or two of them are pale brownish throughout. Krusadai Island.

Diodora clathrata (Reeve).

Fissurella clathrata, Reeve, Conch. Icon., VI, 1851, *Fissurella*, pl viii, fig. 57.

The shell is thick, high and broadly ovate. The apex is nearer the front margin, which is only slightly narrower than the hind margin The sculpture consists of very strong radiating ribs which are raised into transverse nodules at the points where the concentric ridges cross them. The interstices between the radial ribs are represented by deep, narrow grooves ; in each of the interstices in the posterior half of the shell there runs a thin radial ridge much weaker than the main ribs, but they likewise present a beaded appearance owing to the decussation of the concentric ridges The apical hole is small, oval and narrower in front. The shell is pale brownish, marked with several distinct rays of dark brown radiating from the apex. Pamban.

Genus **Emarginula** Lamarck, 1801.

(Syn. **Semparia** Crosse, 1867).

The shell is more or less strongly elevated, and conical or cap-shaped. The apex is inclined backwards ; it is sometimes central, sometimes situated nearer the hind end. The aperture is usually elongately ovate. There is a well defined slit in the anterior margin of the shell along the middle line.

Only a single species has been recorded.

Emarginula obovata A. Adams.[1]

Plate I, fig. 12.

Emarginula obovata, A Adams, Proc. Zool. Soc. London, XIX, 1851, p. 83.
Emarginula sp, Gravely, Bull Mad. Govt Mus. (Nat. Hist.), I, 1927, p. 96.

This species was first recorded from Pamban by Dr. Thurston, and subsequent collection of a few specimens from beneath the Pamban bridge has confirmed this record. The shell is limpet-shaped, oblong-ovate in outline, and moderately elevated. The surface bears

[1] Mr. Winckworth suggests that *Emarginula peasei* which has been recorded from Ceylon may also occur at Pamban, but there is as yet no definite record of this species from the latter locality.

a strongly marked latticed sculpture formed by the reticulation of evenly spaced radial ribs and equally strong concentric ridges ; the even spacing and inter-crossing of the concentric and radial ribs results in the formation of regular, squarish, depressed interspaces which form the meshes of the sculptural network. The apex is situated somewhat nearer to the posterior than the anterior margin, and tends to be slightly inclined backwards. The slit on the anterior margin is very well defined and fairly deep, extending to a point about half way between the anterior end and the apex The shell is uniformly pale brownish. Living specimens are occasionally found attached to rocks and pillars under the bridge. Pamban.

Genus **Scutus** Montfort, 1810.

(Syn. **Scutum** P. Fischer, 1885).

The shell is colourless, somewhat flattened, oblong and shield-shaped, the lateral margins being parallel to one another. The apex is placed behind the middle and is slightly inclined backwards. The front margin is devoid of a slit, but bears a shallow, ill-defined notch.

Scutus unguis (Linné).

Plate I, figs. 13*a* and 13*b*.

Patella unguis, Linné, Syst. Nat., Ed. X, 1758, p. 783.
Scutus unguis, A. Adams, Proc. Zool Soc. London, 1851, p. 221.
Scutus granulatus, Sowerby, Reeve, Conch. Icon., XVII, 1870, *Scutus*, pl. II, fig. 2.
Scutus unguis, Smith, Journ de Conchyl , II, 1879, p. 261
Scutus unguis, Gravely, Bull. Mad. Govt Mus. (Nat Hist.), V, No. 2, 1942, p. 13.

The shell is much flatter and somewhat more elongate than in any of the preceding species of this family. The slit on the anterior margin so characteristic of *Emarginula*, is reduced to a rudimentary notch in this species. The shell does not cover the body of the animal completely ; the entire foot is exposed below the shell, and the edge of the mantle is sharply reflected over the marginal portion of the shell, this condition being very well seen in spirit-preserved specimens. The outer surface of the shell does not show any trace of radial sculpture, but is feebly pitted all over, and finely concentrically grooved. The inner surface of the shell is smooth, and the impression of the mantle is clearly seen on this surface as a line running all round, close to the margin ; anteriorly, the ring formed by this line is incomplete, as its two approaching lateral ends, instead of joining each other, bead sharply backwards and run towards the apex for some distance, close together and parallel to each other, indicating thereby that the mantle is split anteriorly. The shell is dull whitish, sometimes tinged with pale brown. Living specimens have been collected from the reefs. Pamban and Krusadai Island.

SERIES PATELLACEA (= DOCOGLOSSA).

Family PATELLIDAE.

The shell is either strongly or slightly elevated, and is conical or cap-shaped, with the apex placed either in the middle or nearer the front margin. The outer surface is smooth, or more often radiately ribbed, and sometimes even tuberculated. The aperture is ovate or rounded. The animals, popularly known as limpets, live firmly attached to the substratum by means of their broad, oval, flattened foot.

This family is represented by a single genus and species.

Genus **Cellana** H. Adams, 1889.

(Syn. **Helcioniscus** Dall, 1871).

The shell is depressly cone-shaped, the apex is sometimes central, sometimes nearer the front margin ; the inner surface of the shell often displays a pearly lustre. The foot is devoid of glandular furrows. This genus is closely related to *Patella*, from which it is chiefly distinguished by the iridescence of the interior of the shell.

Cellana radiata (Born).

Plate I, figs. 14*a* and 14*b*.

Patella radiata, Born, Index Mus. Caes. Vindobon, 1798, p. 443.
Patella reynaudi, Deshayes, Belanger Voy. Ind Or Zool., 1832, p. 411.
Patella petalata, Reeve, Conch Icon., VIII, 1855, *Patella*, pl. xxii, fig. 56.
Patella aster, ibid , pl. xxx, fig 80
Patella luzonica, ibid., pl. xxxi, fig 86.
Patella frauenfeldi, Frauenfeld, Novara Mollusken, 1865, p. 15.
Acmaea travencorica, Preston, Rec Ind. Mus , VI, 1911, p. 39.
Patella radiata, Gravely, Bull. Mad. Govt Mus (Nat. Hist), V, No. 2, 1942, p. 14.

This is the common limpet found on the rocky shores in India and Ceylon. Mr. Winckworth reports that the record of a species of true *Patella* from Pamban in the previous list was due to the misinterpretation of a spirit specimen which was badly distorted, and admits that the specimen strictly belongs to the present species. The surface of the shell is feebly sculptured with indistinct, scarcely raised radial ribs, but concentric growth striae are also conspicuous The apex of the shell is situated more or less centrally, but may sometimes be slightly nearer the front margin. In many specimens, the apex is whitish, but in some it is very dark-coloured. The shell is generally deep purplish brown, marked externally with a number of whitish rays some of which stop short about the middle without reaching the apex The inner surface of the shell always bears eleven dark-coloured rays which may be wide and single, or more commonly narrow and double ; occasionally they may be broken up into irregular, zig-zag patches. Living specimens of this species are fairly abundant at Pamban, where they have been found attached in large numbers to the huge stone pillars supporting the Pamban bridge at about low water level. Pamban.

SERIES TROCHACEA.

Family TROCHIDAE.

The shell is usually pearly within, seldom porcellanous, and almost always with a well-developed spire. Typically the shell is cone-shaped, but sometimes it is more rounded with more or less inflated whorls, and occasionally much flattened. The foot is provided with an epipodium and the operculum is horny.

The genera of Trochidae represented at Krusadai may be distinguished with the aid of the following key :—

1. Shell in the form of a more or less straight-sided cone with elevated spire and pointed apex	2
— Shell not strictly cone-shaped, whorls usually rounded, inflated or angular ; spire short, more or less depressed, apex generally not sharply pointed ...	5
2. A distinct double spiral ridge, or single, rather enlarged spiral ridge usually present on each whorl immediately above the suture, this ridge being markedly stronger and more raised than the weaker ones which follow above ; ridges smooth, never nodular or granular ; shell without umbilicus	3
— No distinct, single enlarged, or double spiral ridge present on each whorl above the suture, but rows of nodules immediately above the suture may be enlarged ; ridges nodular, tuberculated or granular ; shell with a ' false umbilicus '	4
3. Shell very small, usually with a reduced umbilicus ; enlarged spiral ridge at the bottom of each whorl single	*Cantharidus.*
— Shell much larger ; enlarged ridge at the bottom of each whorl distinctly double ; outer surface of shell sometimes exhibiting a slight pearly lustre	*Calliostoma.*
4. Shell small, base of shell not quite flattened ; outer lip of aperture strongly toothed within	*Clanculus* [1] (part).
— Shell larger, sides of shell usually much straighter, base of shell more perfectly flattened ; outer lip of aperture not toothed within	*Trochus.*

[1] *Clanculus clanguloides.*

5. Shell generally large and thick ; whorls sharply angular about the middle, and divided into a more or less horizontal upper part which is radially plicated and a vertical lower part ; shell often coarse-looking and covered with processes which are generally spinuous ... . *Angaria.*

— Shell usually relatively small ; whorls more or less rounded and not divided into two parts by an angular shoulder as in the above ; surface of shell less coarse-looking, either smooth, or sculptured at most with strong granular spiral ridges only ... 6

6. Shell small, much flattened and with a depressed spire, smooth, highly polished, brightly coloured and displaying a wide range of variation in colour pattern ; umbilicus filled up entirely by a large white callus which spreads over the basal surface of the shell ... ... *Umbonium.*

— Shell not as above, generally not quite so flattened 7

7. Spire well developed, and raised well above the body whorl ; spiral ridges generally strongly granular ; umbilicus sometimes absent in the adult ... 8

— Spire somewhat depressed, not raised much above the level of the body whorl ; spiral ridges smooth, or at most feebly obliquely grooved ; umbilicus always present and well developed in the adult state 9

8 Shell moderately large, and generally thick ; sculpture rather strong and coarse, the spiral ridges often tending to be somewhat unevenly developed ; umbilicus rudimentary or absent in adult shells ... *Euchelus.*

— Shell smaller, and generally not so thick ; sculpture somewhat finer, the spiral ridges being more evenly developed ; umbilicus always present, well developed, wide open and with a toothed margin ... ... *Clanculus* [1] (part).

[1] *Clanculus microdon.*

9. Shell very small; margin of aperture distinctly toothed towards the columellar border; columella lip not much thickened ... ... *Gibbula.*

— Shell larger; margin of aperture not toothed towards the columellar border; columella lip thickened, concave and rendering the opening of the umbilicus narrow ... ... *Monilea.*

Genus **Euchelus** Philippi, 1847.

The shell is rounded, with more or less inflated whorls, the body whorl being conspicuously broader than those of the spire; the surface of the shell is often traversed by unequally developed spiral ridges which are usually granular or nodular. The aperture is rounded.

Three species of *Euchelus* have been recorded; they may be distinguished as follows:—

1. Whorls moderately inflated; sutures deeply set in narrow grooves; profile of body whorl somewhat angular about the middle in the adult; granules on spiral ridges circular 2

— Whorls strongly inflated; sutural groove wider and less deep; profile of body whorl perfectly rounded about the middle both in young and adult shells; granules on spiral ridges obliquely transpirally elongated ... ... *E. circulatus.*

2. At most three (sometimes only two) spiral ridges on each whorl stouter and more strongly raised than the rest; surface of columella lip broad and transversely ridged throughout; a single tooth on the columellar border of aperture strongly developed ... ... *E. asper.*

— Number of spiral ridges which are thicker and more strongly raised than the rest more than three, usually about five; surface of columella lip narrow and smooth; the single tooth on the columellar border of aperture small and feebly developed ... *E. atratus.*

Euchelus asper (Gmelin).

Plate II, figs. 1*a* to 1*c*.

Trochus asper, Gmelin, Syst. Nat., Ed XIII, 1791, p 3583.
Euchelus indicus, A. Adams, Proc Zool. Soc London, 1854, p. 316
Trochus asper, Fischer, in Kiener, Coq Viv., XI, 1878, p. 287, pl 93.
Euchelus principalis, Pilsbry, Man. Conch., XI, 1889, p 439
Euchelus asper, Crichton, Journ Bomb Nat. Hist Soc, XLII, 1941, p 336
Euchelus asper, Gravely, Bull Mad Govt Mus. (Nat Hist), V, No 2, 1942, pp 15 and 16.

This is a somewhat variable species The shell is thick, fairly large, with moderately inflated whorls and a well elevated spire. The shell is always more or less strongly spirally ridged, and the ridges bear close-set circular granules. The outer lip of the aperture is very thick and its edge appears as if it has been obliquely cut off ; the margin of the aperture is grooved throughout, but there is a strong, well marked tooth somewhere near the lower end of the columella The shell is generally of a deep bluish grey colour, fading into a pale ashy brown in worn shells. The surface of the shell often tends to be corroded or covered with various encrustations (worm tubes, etc.), this condition being particularly well marked in shells collected from under the Pamban bridge. Living specimens have been collected both from this locality and the reef adjoining Krusadai Island.

Euchelus asper var. tricarinatus Lamarck, a distinct variety of this species, is also represented in the Pamban area ; in this variety, three of the spiral ridges in each whorl are more strongly developed, and often more or less markedly crested ; but there are some specimens in the collection showing intergradations between this and the typical form in which the spiral ridges are more or less uniform.

Young shells have a well developed umbilicus, but full-grown ones show no trace of it. Pamban, Krusadai Island and Kundugal Point.

Euchelus circulatus (Anton).

Trochus circulatus, Anton, Zeitschr f Malak, 1848 (1849), p 103
Euchelus proxima, A Adams, Proc Zool Soc London, XXII, 1854, p 316.
Euchelus circulatus, Pilsbry, Man. Conch, XI, 1898, p 432
Euchelus circulatus, Gravely, Bull Mad Govt Mus (Nat Hist.), V, No 2, 1942, pp. 15 and 16.

This species is readily distinguished from the preceding one by the whorls of the shell being more strongly inflated and by the granules on the spiral ridges being more or less obliquely and transpirally elongated. The spire is less strongly elevated. The whorls are spirally ridged, but on each whorl there are three equally spaced, strongly crested spiral ridges, and on the body whorl usually one more (of such crested ridges) is developed below the three normally present ones. The aperture and its margin are very much like those

of the preceding species. The shell is generally of a pale reddish brown colour, but many of the ridges tend to be whitish ; there are often many oblique, irregular, transpiral rows of dark purplish brown spots which stand out conspicuously on a pale background. In young shells, the umbilicus is well developed, but in full-grown ones there is a mere depression indicating its presence. Dry shells are commonly found washed up on the beach. Pamban and Krusadai Island.

Euchelus circulatus var. proxima A. Adams, has also been recorded from Pamban, but is much rarer, and represented by dead shells only. In this variety the spiral ridges on the shell are more or less uniformly developed. Pamban.

Euchelus atratus (Gmelin).

Turbo atratus, Gmelin, Syst Nat., Ed XIII, 1791, p 3601.
Euchelus atratus, Pilsbry, Man Conch XI, 1898, p. 439, pl 38, fig 22.
Trochus (Euchelus) atratus, Watson, "Challenger," Zoology, XV, 1866, Gastropoda, p. 52.
Euchelus atratus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 70.

In this species the shell is rather variable in shape and colouration ; in many respects the shell closely resembles those of the two preceding species. It may, however, be distinguished from *E. asper* by the greater number of strongly developed spiral ridges on each whorl and by the shell being of a reddish brown colour, and from *E. circulatus* by the granules on the spiral ridges being circular instead of transpirally elongated and by the whorls being narrower and less strongly inflated. The middle part of the body whorl tends to be somewhat angular in full-grown shells, but is more evenly rounded in young shells. As in *E circulatus* the shell is usually marked by irregular, obliquely transpiral rows of purplish brown spots, these spots tending to be more distinct on the stronger spiral ridges especially in young shells. Pamban.

Genus **Calliostoma** Swainson, 1840.
(Syn. **Zizyphinus** Gray, 1847).

The shell is conical, generally broader than tall ; the body whorl is sharply angular below ; the outer surface of the shell sometimes has a pearly lustre, and is either smooth or feebly spirally sculptured. In the *Calliostoma s. str.* section of the genus, to which the Pamban species belong, the shell is without an umbilicus.

Two species, *C. tranquebaricus* and *C. polychroma*, have been recorded. In the former the shell is broader than high and the outer surface displays an iridescent pearly lustre and is relatively smooth, while in the latter the shell is much narrower, higher than broad, and the surface is more strongly sculptured.

Calliostoma tranquebarica (Röding).

Trochus tranquebaricus, Röding, Mus Bolten, 1798, p 83
Trochus tranquebaricus, Chemnitz, Conch Cab., V, 1840, p. 68, pl 166, figs 1595 and 1596.
Zizyphinus tranquebaricus, A Adams, Proc Zool. Soc. London, 1851, p 164.
Zizyphinus tranquebaricus, Reeve, Conch. Icon., XIV, 1864, *Zizyphinus*, pl. iii, fig. 15
Calliastoma tranquebarica, Gravely, Bull. Mad Govt Mus. (Nat Hist), V, No. 2, 1942, pp 15 and 16.

This species is much commoner on the Madras coast than in the Pamban area. The shell is conical, slightly broader than high, with broad, abruptly flattened base, straight sides and sharply pointed apex. The outer surface is somewhat glossy and often displays a silvery lustre. At the lowermost part of each whorl there is a stout double spiral ridge followed by much weaker spiral striae in the upper part of the whorls, the flat basal surface of the body whorl is also feebly spirally ridged. The aperture is rather small, antero-posteriorly compressed and transversely ovate. An umbilicus is absent ; the columellar border of the aperture is smooth and distinctly pearly. The shell is whitish or very pale yellowish brown, often marked with a number of brownish spots or patches. Only dead shells are represented. Pamban.

Calliostoma polychroma (A. Adams).

Zizyphinus polychroma, A Adams, Proc. Zool Soc London, 1851, p. 168
Zizyphinus polychroma, Reeve, Conch. Icon, XIV, 1864, *Zizyphinus*, pl vi, fig. 4.

The shell is much smaller than that of the preceding species ; it is evenly conical, and, as in *Trochus pustulosus*, narrow and considerably higher than broad. The shell is sculptured with regular, close-set, spiral ribs, which, however, are not nodular or tuberculated as in species of *Trochus*. The lowermost ribs on each whorl are stouter and more strongly raised than the ones above them, forming a marked, elevated, double ridge, at the bottom of each whorl. The basal surface of the body whorl is also traversed by smooth, spiral ribs. The columella is not denticulated. The shell is whitish, marked with brownish red, transpiral bands which are often broken up in the upper whorls, giving a mottled appearance. This species is uncommon Pamban.

Genus **Gibbula** Risso, 1826.

The shell is small, conical, more or less elevated, usually umbilicated, smooth or spirally sculptured ; sometimes the upper part of the whorls is tuberculated ; the body whorl is somewhat angular.

A single species, represented by two shells from Mr. Crichton's duplicate collections, has been recorded.

Gibbula blanfordiana Nevill.

Plate II, fig. 2.

Gibbula blanfordiana, Nevill, Journ Roy. Asiat. Soc. Bengal, XXXVIII, 1869, p. 158.

The shell is small with a rather depressed spire and a broad, more or less flattened body whorl. The sculpture consists of evenly developed, strong, spiral ridges and much weaker ones running in the interstices between the main ridges spirally ; the weaker ridges are sometimes indistinct or even absent ; the strong ridges extend throughout the somewhat flattened basal surface of the body whorl. The umbilicus is small, but distinct. The margin of the aperture is distinctly toothed towards the columellar border. The outer surface of the shell is pale yellowish brown, marked with numerous dark brown spots, those at the lower edge of the body whorl being larger and more well marked. This species appears to belong properly to the sub-genus *Cantharidella* Pilsbry, 1889, rather than to *Gibbula s. str.*, which is Atlantic and Mediterranean in distribution. Pamban.

Genus **Cantharidus** Montfort, 1810.

The shell is usually high, conical, and as a rule without an umbilicus. The outer surface is either smooth or sculptured ; the inner surface is distinctly pearly. The columellar border is thick, often ridged or toothed below. A single species is represented in the collection.

Cantharidus (Jujubinus) interruptus (Wood).

Plate II, fig. 3.

Trochus interruptus, Wood, Index Test Suppl , 1828, pl vi, fig. 39.
Cantharidus articularis, A. Adams, Proc. Zool Soc. London, 1851, p. 169.
Calliostoma planiliratum, Sowerby, Ann Mag Nat. Hist , XVI, 1905, p. 184.

The shell is small and resembles very much that of a young *Trochus* in general appearance. It is conical, definitely higher than broad, with a sharply pointed apex and straight, even sides ; the whorls are not inflated but have straight, flattened walls. The lower part of the body whorl is sharply angular and its base obliquely flattened. The sculpture consists of an evenly spaced spiral ribbing, the ribs being separated by narrow, groove-like interstices; the lowermost ridge in each whorl is stouter and more strongly raised than the rest ; the interstices between the spiral ridges are minutely transpirally ridged. The umbilicus is reduced to a shallow pit. The columellar border of the aperture is thick and finely ridged ; the aperture is somewhat squarish. The colouration of the shell is rather variable ; it is usually whitish, with a tesselated pattern of reddish or rusty brown spots or patches, the spots on the stout ridge at the bottom of each whorl being specially well marked. The sub-genus *Jujubinus* Monterosato, 1884, to which this species belongs has sometimes been wrongly referred to *Calliostoma* ; but in shell form and radula it is closely related to

Cantharidus s. str. The material for this species consists of a few dry shells from Mr. Crichton's duplicate collection. Pamban.

Genus **Clanculus** Montfort, 1810.

The shell is conical or top-shaped, usually with granular spiral ridges ; the aperture is oblique, often toothed inside ; the columellar margin is bounded by a well marked callosity above.

Two species, *C. clanguloides* and *C. microdon*, are known from Pamban. The former is by far the commoner of the two, and may be readily distinguished from the latter by the shell being relatively high and more strictly conical, and by the outer lip of the aperture being thicker and armed with powerful teeth within.

Clanculus clanguloides (Wood).

Plate II, figs. 4*a* and 4*b*.

Trochus clanguloides, Wood, Index Test Suppl , 1828, pl vi, fig 39.
Clanculus stigmarius, A. Adams, Proc Zool Soc London, 1851, p 161
Clanculus stigmatarius, Fischer, in Kiener, Coq. Viv , XI, 1877, p 217, pl. 71, fig. 4
Clanculus clanguloides, Hornell, Common Molluscs of South India, Mad Fish Bull., XIV, 1921, p. 105.

The shell is small and conical, with a markedly inclining base. The lower edge of the body whorl is not sharply angular as in *Calliostoma*. The surface is traversed by a number of granular spiral ridges which give the sculpture a characteristic beaded appearance ; the interstices between the spiral ridges are minutely transpirally striated. The aperture is oblique, more or less rectangular and armed with stout, strongly developed teeth on the columellar lip, the outer lip and at the base (*i.e.*, anterior end) of the columella , one tooth in the upper part of the outer lip is particularly strong and conspicuous. The shell bears a 'false umbilicus' (a characteristic feature which *Clanculus* shares with the next genus, *Trochus*), that is to say, the umbilicus actually surrounds the columella, so that the umbilicus, instead of being a simple, hollow cone, is a twisted surface bounded by a free spiral ridge running from the apex to the columella. The shell is generally reddish brown, marked all over with dark spots. This is a moderately common species in the Pamban area, the shell being frequently found washed up on the beach in fairly large numbers. Pamban, Krusadai and Shingle Islands.

Clanculus microdon A. Adams.

Plate II, fig. 5.

Clanculus microdon, A. Adams, Proc Zool Soc. London, XIX, 1851, p. 162
Trochus (Clanculus) microdon, Smith, Proc Zool Soc London, 1878, p 818
Clanculus microdon, Gravely, Bull Mad Govt Mus (Nat Hist), V, No 2, 1942, p 15

The shell is slightly larger than that of the preceding species, but relatively depressed flatter, and more or less top-shaped, with more rounded whorls. The sculpture consists of

beaded spiral ridges which are for the most part alternately stout and thin, except on the somewhat flattened basal surface of the body whorl where they are all more or less uniformly strong ; the interstices between these spiral ridges are traversed by minute, oblique striae which are distinctly seen under the lens. The umbilicus is rounded and has a toothed margin. The aperture is larger than in *C. clanguloides*, and its margin is not strongly toothed as in that species. The shell is dark reddish brown, marked with white spots. This species is not common, and is represented in the Museum collection by two dry shells. Pamban.

Genus **Trochus** Linné 1758.

The shell is conical and straight-sided ; the lower part of the body whorl is usually angular, its basal surface being more or less flattened ; the columella lip is twisted, its margin being often toothed. A 'false umbilicus' is developed as in the preceding genus.

The four species of *Trochus* recorded from Krusadai may be distinguished from one another as follows :—

1. Shell narrow, definitely higher than broad ; sculpture as a rule not coarse-looking, and consisting usually of small, rounded, close-set nodules arranged in spiral rows ... ... *T. pustulosus.*
— Shell broader, about as broad as high, or even broader than high ; never higher than broad ; sculpture as a rule somewhat more coarse-looking ; tubercles forming the spiral rows slightly larger and not so close-set ; lower part of each whorl with or without a swollen fillet of tubercles 2
2. Columella not denticulated ; upper rows of tubercles in each whorl larger than those of the lower spiral ridges ... ... *T. radiatus.*
— Columella denticulated ; lower rows of tubercles in each whorl swollen and more prominent than those of the upper spiral ridges 3
3. Profile of shell slightly rounded, instead of being strictly conical and straight-sided ; the two lowermost rows of tubercles in each whorl forming a fillet which is moderately pronounced ... ... *T. stellatus.*
— Profile of shell more evenly conical, the sides being straighter ; fillet in the lower part of each whorl stouter, more strongly developed and diagonally ribbed .. .. *T. tentorium.*

Trochus radiatus Gmelin.

Plate II, figs. 6*a* and 6*b*.

Trochus radiatus, Gmelin, Syst Nat., Ed XIII, 1791, p 3572.
Trochus radiatus, Reeve, Conch Icon, XIII, 1861, *Trochus*, pl. xiv, fig 80.
Trochus vividus, Reeve, ibid, pl xiii, fig 72.
Trochus radiatus, A Adams, Proc Zool Soc London, 1851, p 185

This is the commonest species of *Trochus* recorded from the Pamban area and its shell is one of the most familiar among the Gastropod shells frequently washed up on the beach in that locality. Dry shells are particularly abundant on the sandy beaches of Krusadai and Shingle Islands, while living specimens (often with weedy encrustations) are not uncommon on the reefs adjoining the Islands. The shell is moderate-sized, slightly broader than high, and of a more or less evenly conical shape. The surface of the whorls is traversed by regular, spiral rows of rounded tubercles, but the upper rows of tubercles in each whorl are larger than those of the lower rows. The basal surface of the body whorl is strongly spirally ridged. The columella is smooth and not denticulated. The shell is whitish or pale yellowish, brightly marked with broad, transpiral, dark reddish bands which often get broken up into irregular reddish spots on the basal surface of the body whorl. Pamban, Krusadai and Shingle Islands.

Trochus stellatus Gmelin.

Plate II, figs 7*a* and 7*b*.

Trochus stellatus, Gmelin, Syst Nat, Ed. XIII, 1791, p. 3571.
Trochus stellaris, Roding, Mus Bolten, 1798, p. 81.
Trochus stellatus, A Adams, Proc. Zool. Soc. London, 1851, p 153.
Trochus incrassatus, Reeve, Conch. Icon, XIII, 1861, *Trochus*, pl. xiii, fig 77.
Trochus stellatus, Gravely, Bull. Mad Govt Mus. (Nat. Hist.), V, No. 2, 1942, pp 15 and 16.

The shell is somewhat thicker and more massive than in the preceding species, with its sides slightly arched so as to give a somewhat round profile to the conical shell. The sculpture consists of spiral rows of tubercles as in *T. radiatus*, but the tubercles of the two lowermost spirals in each whorl are enlarged and form a well marked fillet. The spiral ridges on the basal surface of the body whorl are granular. The columella is denticulated, but there is considerable variation with regard to this feature, and, based on this, two more or less distinct varieties may be distinguished. In the form *incrassatus* the teeth on the columella are strongly developed, while in the form *stellaris* they are small and merely granular ; but an examination of a series of shells from any particular locality will show many intergradations between these two forms. As in *T. radiatus*, the shell is ornamented with broad radial reddish bands. This species is much less common than the preceding one, but as a rule plenty of shells are washed up on the beach. Shingle Island and Pamban.

Trochus tentorium Gmelin.

Plate II, fig. 8.

Trochus tentorium, Gmelin, Syst. Nat., Ed. XIII, 1791, p. 3571, No. 24.
Trochus costatus, Gmelin, ibid, No 28.
Polydonta tentorium, A Adams, Proc Zool Soc. London, 1851, p 153
Trochus tentorium, Reeve, Conch. Icon, XII, 1861, *Trochus*, pl. iii, fig 14

The shell may at once be distinguished from those of the preceding species by its more strongly nodular surface. The sides of the shell are more or less straight, much as in *T. radiatus*. The lower rows of tubercles in each whorl are enlarged as in *T. stellatus*, but they are much stronger and more pronounced, and the stout fillet which they form is traversed by strong, thick, oblique, transpirally elongated ribs. The basal surface of the body whorl bears beaded spiral ridges. The columella is distinctly denticulated. As in the preceding species, the shell is marked with transpiral reddish bands, but they are much closer together in this species, and often broken up into patches which are darker and more conspicuous in the lower part of each whorl. Krusadai and Shingle Islands.

Trochus pustulosus Philippi.

Plate II, fig. 9.

Trochus pustulosus, Philippi, Zeitschr, f Malak., 1849, p 188
Polydonta corrugata, A Adams, Proc Zool Soc. London, 1851, p 155
Trochus (Polydonta) calcaratus Souverbie, Journ de Conchyl, XXIII, 1873, pp. 41 and 296.
Trochus crebigrantus, Reeve, Conch Icon., XIII, 1861, *Trochus*, pl xv, fig 89

The shell is much narrower than in any of the three preceding species, slightly smaller in average size, and definitely higher than broad The general shape and form of sculpture of the shell closely approach Reeve's figure of *T. crebigrantus*. The shell is more or less evenly conical, with straight sides. The sculpture consists of close-set spiral rows of rounded nodules extending throughout the surface There is a swollen fillet at the bottom of each whorl as in *T. tentorium*, but the tubercles are nodular, and, in fresh specimens, even pustular ; in worn shells this fillet of nodules tends to be much less distinct. The basal surface of the body whorl bears granular spiral ridges. The columella is denticulated. Mr. Winckworth reports that this species is the same as *T. corrugatus* A. Adams, the type of which is represented in the British Museum collection, but that the name is preoccupied by that of Philippi in 1849. The colour of the shell is generally a dull brick-red, marked with narrow, whitish, transpiral streaks, which latter may, however, be broader, reducing the reddish area to wide transpiral bands. Dry shells of this species are particularly common on the beach of Shingle Island. Live specimens have not yet been collected. Krusadai and Shingle Islands

Genus **Monilea** Swainson, 1840.

The shell is somewhat flattened and top-shaped and is sculptured with granular spiral ridges. The umbilicus is bounded below by the spirally twisted columellar border. The columella is thickened below.

A single species has been recorded.

Monilea solandri (Philippi).

Plate II, figs. 10*a* and 10*b*.

Trochus solandri, Philippi, in Martini-Chemnitz, Conch Cab, Ed II, 1851, *Trochus*, p. 180, pl 28, fig 8.
Monilea solandri, Pilsbry, in Tryon's Man Conch, XI, 1890, p 252, pl. 61, fig. 10

The shell is moderate-sized, with a rather depressed spire and a broad, flattened body whorl, the lower part of which is more or less evenly rounded instead of being sharply angular as in *Trochus*. The sculpture consists of close-set spiral ridges, which, in their turn, are traversed by obliquely transpiral ribs ; the interstices are in the form of narrow, deeply impressed grooves ; the ridges on the basal surface of the body whorl are transversely grooved. The umbilicus is moderately wide but its mouth is somewhat narrowed by a concave, ridge-like thickening of the columella lip. The shell is pale brownish, waved transpirally with dark brown bands which are more distinct on the basal surface of the body whorl. This species is rare and represented in the collection only by two dry shells. Pamban.

Genus **Umbonium** Link, 1806.

(Syn. **Rotella** Lamarck, 1822).

The shell is flattened, button-shaped, usually with a smooth and glossy surface. The umbilicus is filled up with a thick callus.

A single species is known from Pamban.

Umbonium vestiarium (Linné).

Plate II, figs 11*a* to 11*e*.

Trochus vestiarius, Linné, Syst Nat, Ed X, 1758, p 758.
Umbonium vestiarium, Link, Besch Nat Samm Rostock, pt 3, 1807, p 136.
Rotella lineolata, Lamarck, Anim. sans vert., VII, 1822, p. 7.
Umbonium vestiarium, A Adams, Proc Zool Soc London, 1853, p 187.
Rotella vestiaria, Sowerby, Reeve, Conch Icon, XX, 1878, *Rotella*, pl III, fig 12
Umbonium (Rotella) vestiarium, Hornell, Common Molluscs of South India, Mad Fish. Bull., XIV, 1921, p. 105.
Umbonium vestiarium, Gravely, Bull Mad Govt Mus (Nat. Hist), V, No 2, 1942, pp. 15 and 16.

This species is common on all Indian sandy shores and is represented abundantly in the Pamban area. The shell is small and brightly coloured, with a smooth, highly polished surface ; the spire is depressed, and the body whorl broad and more or less markedly flattened and strongly angular below. The aperture is flattened and somewhat D-shaped. The

umbilicus is filled up entirely by a thick, whitish callus which spreads over the basal surface of the shell. The colouration and colour pattern of this pretty shell presents a wide range of variation and this has been responsible for the numerous synonyms for this species. The following are some of the characteristic colours and colour patterns commonly met with :—

(*a*) Pale brownish, greenish or reddish brown, with numerous transpiral, close-set, white, straight or wavy or arrow-head-shaped lines, which may sometimes be thicker and more widely separated. This appears to be the commonest pattern.

(*b*) More or less uniformly pink or rose-coloured, sometimes with whitish or brownish transpiral bands in the upper whorls of the spire.

(*c*) Brownish yellow, with a broad, continuous, purplish, spiral band, crossed by white transpiral lines, running close below the suture in each whorl.

(*d*) White, with a broad, dark purplish spiral band running immediately below the sutures.

(*e*) Brown, with a white spiral line, running continuously from the angular part of the body whorl to the apex of the spire, along the suture.

(*f*) Pale brown, with fine, close-set, wavy, transpiral white lines, and a thick, pink spiral band running in the lower half of each whorl, close above the suture.

(*g*) Pale pink throughout, with fine, dark spots along the suture in the upper whorls of the spire ; angular part of the body whorl sometimes marked with white streaks or mottled with white and brown spots.

(*h*) Uniformly bronze-coloured. This type appears to be the most rare.

These molluscs live in the surface layers of sand in shallow water ; living specimens of this species have been collected in large numbers from the sand at Watchman's Bay on Krusadai Island and on the Kundugal mud flats, where they are abundant. As they are capable of burrowing rapidly in the soft sand with their slender, pointed foot, they are not always seen actually on the surface, but literally handfuls of them may be collected if the sand is dug up to a depth of about two or three inches Pamban, Kundugal Point, Krusadai and Shingle Islands.

Genus **Angaria** Röding, 1798.

(Syn. **Delphinula** Lamarck, 1803).

The shell is moderately large, thick, with a low and flattened spire. The whorls are sharply angular and furnished with large, spiny or foliaceous processes. An umbilicus is present and the operculum is horny.

Two species, *A. plicata* and *A. atrata* are represented ; the latter may be readily distinguished from the former by the smaller shell and by the processes on the shell being relatively long and more strongly spiny.

Angaria plicata (Kiener).

Plate II, figs. 12*a* and 12*b*.

Delphinula rugosa, Kiener, Coq Viv , pt. 28, 1838, *Delphinula*, pl 3, fig 4.
Delphinula plicata, Kiener, Coq. Viv , pt 29, 1838, *Delphinula*, p 4.
Delphinula distorta, Reeve, Conch. Icon , I, 1843, *Delphinula*, pl ii, fig 7
Delphinula distorta, Sowerby, Thes Conchyl , V, 1884, pl 477, fig 4

There has been considerable confusion with regard to the naming of this species, the name *distorta* having been used by several authors ; but Kiener's name, *plicata*, has priority over the others. This is a moderately large, thick, somewhat massive, reddish shell, with a very rough, coarse-looking surface. The body whorl is large and of considerable width ; *it is covered with blunt, spiny processes all over, but the spines are much less developed* than in most other species of this genus The spire is low, and the whorls are more or less sharply angular about their middle, being thereby divided into a horizontal upper part which bears thick, transpiral folds, and a vertical lower part. The surface is traversed throughout by strong spiral ridges, of which those on the lower part of the whorls are often drawn out into short spiny processes, but the latter may be indistinct or even absent when the shell is worn out, this being the condition in which specimens washed up on the beach are generally found ; in fresh shells, however, the processes are well marked especially on the angular portion of the whorls. The umbilicus is large and beset with spiny processes within. Only empty shells have been collected. Krusadai and Shingle Islands.

Angaria atratus (Gmelin)

Plate II, figs. 13*a* and 13*b*

Turbo atratus, Gmelin, Syst Nat , Ed XIII, 1791, p 3601
Der geshwartze Delphin, Chemnitz, Conch Cab , V, 1781, p 158 pl 175, figs. 1729, 1730, and 1731.
Delphinula atrata, Reeve, Conch. Icon , I, 1843, *Delphinula*, pl i, fig 4
Delphinula atrata, Pilsbry, Man Conch , X, 1896, p 267, pl 66, fig 15.
Delphinula lacinata, var atrata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 33

The shell is thinner, smaller and more strongly spinuous than in the preceding species. The whorls of the spire are considerably flattened and form a more or less horizontal platform raised a little above the level of the body whorl which is strongly and angularly shouldered about the middle ; its upper part is radially plicated as in *A. plicata* , the part of the whorl below the angle bears spiral rows of stiff, pointed spines, but those at the angular shoulder are much the strongest and project most ; they are upwardly curved and their pointed tips are apt to get broken off in worn shells. The umbilicus is large. The shell is more or less uniformly deep purplish red. This species is uncommon and represented by only a single dry shell in the collection. Pamban.

Family TURBINIDAE.

The shell varies greatly in shape and size. It is orbicular, rounded, top-shaped, elongately ovoid or even conical. As a rule the body whorl is enlarged and moderately inflated. The operculum is thick and calcareous. The shell is usually pearly within, but in worn shells this may not be evident. In the sub-family *Phasianellinae,* which includes the so called pheasant shells, the spire is more strongly elevated and the interior is not pearly.

The four genera which are represented at Pamban may be distinguished as follows :—

1. Shell conical, trochiform, flattened below ; a spiral row of prominent, spine-like tubercles present on the lowermost part of the surface of each whorl ... *Astraea.*

— Shell not conical and trochoid, base of shell more rounded, not flattened ; whorls usually rounded, sometimes shouldered in the middle ; spiny processes at lowest part of each whorl absent ... 2

2. Shell thin, elongately ovoid, with considerably elevated spire ; inner surface of shell not pearly ; umbilicus absent ... ... *Phasianella.*

— Shell thicker, proportionately broader and less elongate, with a comparatively short spire ; body whorl usually markedly inflated ; umbilicus usually present and open, but occasionally filled with callus 3

3. Shell small, uniformly whitish, with widely open umbilicus and more or less depressed spire ; whorls rather angular, with a strongly marked latticed sculpture consisting of raised transpiral ribs connected by thinner spiral ribs ... ... *Liotia.*

— Shell large, not uniformly white, variously coloured, umbilicus smaller or even closed by callus ; spire well developed not flattened or depressed ; whorls rounded and more or less inflated ; sculpture when present not as above ; spiral sculpture predominating ... ... *Turbo.*

Genus **Liotia** Gray, 1847.

The shell is as a rule top-shaped, with strong sculpture consisting of a lattice of spiral and transpiral ribs. The umbilicus is large and the operculum often bears a row of pearly granules.

A single species is represented.

Liotia cidaris (Reeve).

Plate III, figs. 1*a* and 1*b*.

Delphinula cidaris, Reeve, Proc Zool Soc London, 1843, p. 143.
Delphinula cidaris, Reeve, Conch. Icon , I, 1843, *Delphinula*, pl. v, fig 27.

Reeve has treated this species as a member of the genus *Delphinula*, probably by reason of the close external resemblance of the shell to that of a young *Angaria* (= *Delphinula*) which, however, strictly belongs to the family Trochidae ; but the radular characters of this species definitely determine its position under the genus *Liotia*, which falls under the family Turbinidae. The shell is small, rounded and somewhat broadly disc-shaped with a more or less depressed spire ; the whorls are strongly angular about the middle as in *Angaria plicata*, but lacks the blunt, coarse-looking processes characteristic of that species. The whorls have a more or less polygonal outline ; they are divided by the median angular shoulder into a horizontal upper part and a vertical lower one. The sculpture is characteristically in the form of a strong lattice made up of stout, raised transpiral ribs, connected by finer spiral ridges in the interstices. The basal surface of the body whorl presents a circular row of depressions ; the umbilicus is widely open. The shell is pure white throughout. The largest specimen in the collection measures about 13 mm. wide and 7 mm. high, but most of the shells collected are much smaller. Pamban, Krusadai and Shingle Islands.

Genus **Turbo** Linné, 1758.

The shell is more or less top-shaped with well developed spire and rounded whorls. The lower surface is rounded or inflated, never flattened The operculum, when present, is thick, calcareous, with a nearly central nucleus and three to four whorls on the flat inner surface ; its outer surface is rounded, smooth or variously sculptured.

Two species, *T. intercostalis* (= *T. brunneus*) and *T. petholatus* have been recorded from Krusadai. The former is much the commoner of the two ; its shell is readily distinguished from that of the latter by the presence of a strong sculpture of spiral ridges, while in the latter the shell is quite smooth.

Turbo intercostalis Menke.

Plate III, fig. 2.

Turbo intercostalis, Menke, in Philippi, Conch. Cab., Ed. II, 1847, 1849, *Turbo*, p. 42, 68, pl. 11, fig. 3, pl. 16, figs 4 and 5.
Turbo intercostalis, Kiener, Coq. Viv, 1873, *Turbo*, p 83, pl 39, fig. 1.
Turbo articulatus, Reeve, Conch. Icon, IV, 1847, *Turbo*, pl ix, fig 39.
Turbo intercostalis, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 24.
Turbo brunneus, Gravely, Bull Mad Govt Mus. (Nat Hist), V, No. 2, 1942, p. 17.

This is one of the commonest species of Gastropods occurring at Krusadai, and is the common turban shell of the South Indian shores. Living specimens are frequently found in large numbers under blocks of stone and in the crevices of dead coral on the reefs ; and many of them collected from beneath the Pamban bridge are of a particularly large size. The shell is thick, moderately large and beautifully pearly within. The surface of the shell bears stout, raised spiral ridges which are for the most part alternately strong and weak, but on the basal surface of the body whorl they are all uniformly strong. The ridges are finely and closely transpirally grooved, these grooves being specially well marked on the lowermost ridges of the body whorl ; the grooves on the ridges are continued on to the interstices between the ridges as fine transpiral striae ; these finer details of sculpture are seen distinctly only in fresh, unworn shells. The umbilicus is present and open. The aperture is large and rounded. The operculum of this species is very characteristic ; it is a solid, calcareous, more or less hemispherical body with a flat inner surface marked with an impressed spiral line representing its whorls, and a convex outer surface rather dark-coloured in the centre and finely reticulately sculptured. The colour of the shell is slightly variable , it is normally dark or greenish brown, irregularly marked with yellowish spots or patches. Both live specimens and empty shells washed up on the beach are abundant. Pamban, Krusadai and Shingle Islands.

Turbo petholatus Linné.

Plate III, fig. 3.

Turbo petholatus, Linné, Syst. Nat, Ed X, 1758, p. 762, No 533.
Turbo petholatus, Reeve, Conch. Icon., IV, 1848, *Turbo*, pl. iii. fig. 12
Turbo petholatus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 23.
Turbo petholatus, Watson, "Challenger", Zoology, XV, 1886, Gastropoda, p. 124

The shell is larger in average size than that of *T. intercostalis*, and has a broader and more strongly inflated body whorl. The surface of the shell is smooth and even somewhat glossy, being totally devoid of sculpture, but Schepman reports that very young specimens in the Siboga collection bear microscopic striae running almost spirally. The aperture is large and rounded, and the umbilicus is entirely filled up by a large whitish callus deposit. The colour pattern of the shell is very characteristic , it is brownish, marked with large irregular blotches of dark reddish brown and encircled by widely set, dark chestnut spiral

bands, which in their turn bear white transpiral markings, the latter sometimes taking the shape of arrow-heads ; on the whorls of the spire there are only two, or at most three, of these spiral bands, but on the body whorl there are about five or six ; the columellar border of the aperture is bright yellowish, but this is sometimes faded. Only empty shells have yet been collected , they are not uncommonly found washed up on the beach, especially on Shingle Island. Its operculum is not represented in the collection. Krusadai and Shingle Islands.

Genus **Astraea**[1] (Bolten) Röding, 1798.

The shell is conical or top-shaped with or without an umbilicus The basal surface is usually flattened The whorls are keeled and often more or less spinuous. The operculum is horny and ovate.

A single species is represented.

Astraea semicostata (Kiener).

Plate III, figs. 4*a* and 4*b*.

Trochus stellatus, Philippi, Conch Cab , 1848, *Trochus*, pl 21, fig. 4 ; (also of Reeve, Conch. Icon. ; non *Trochus stellatus* Gmelin)
Trochus semicostatus, Kiener, Coq Viv , 1850, *Trochus*, pl 38, fig 1
Calcar semicostatum, Fischer, in Kiener, Coq viv , 1875, *Trochus*, p 35
Astralium semicostatum, Pilsbry in Tryon, Man Conch , X, 1889, p 237.

The shell resembles very much that of a typical *Trochus*, being conical and trochiform with a strongly flattened base. The lowermost part of each whorl is beset with a spiral row of strong, short, spine-like tubercles, which are often more or less downwardly inclined and sometimes slightly obliquely elongated ; the upper part of the surface of the whorls above the spinuous row bears feebly developed, rather widely separated, oblique transpiral ribs. The lower edge of the body whorl is sharply angular, and its flattened basal surface is finely and closely concentrically grooved throughout. The umbilicus is filled up by a thick whitish callus, and the aperture is much smaller in proportion to the size of the shell than in species of *Turbo* The shell is pale yellowish brown, often bleached into a uniform dull white in empty shells washed up on the beach, which alone are represented in the collection. In very worn shells the keel and the spines at the bottom of each whorl are naturally indistinct and may have even disappeared. Krusadai and Shingle Islands

Genus **Phasianella** Lamarck, 1804.

The shell is oblong-ovoid, with well developed and considerably elevated spire, and a body whorl which is higher than broad The external surface is brightly coloured, while the interior is whitish and without pearly lustre. The operculum is smooth and glossy. An umbilicus is absent.

A single species is known from Pamban.

[1] Mr Winckworth reports that if the International Commission ever decide to abolish *Astraea*, because of its similarity to the later *Astraea* (a coral), *Astralium* is available as a generic name

Phasianella nivosa Reeve.

Plate III, fig. 5.

Phasianella nivosa, Reeve, Conch. Icon , XIII, 1862, *Phasianella*, pl. iv, fig 8.
Phasianella nivosa, Sowerby, Thes. Conchyl , V, 1884, p. 150, pl. 475, figs. 7 and 8
Phasianella nivosa, wrongly included in synonomy of *P variegata*, Lamarck, by Pilsbry in Tryon, Man. Conch., X, 1889, p 179.
Phasianella (*Orthomesus*) *nivosa*, Dautzenberg, Faun Col. Franç , 1929, III, p. 529 ; (Madag., p. 323).

Four shells of this species have recently been collected from the Pamban area. The shell is somewhat small, measuring at most about three-fourth inch in length, moderately thin, and not unlike that of a small *Littorina* in shape and general appearance. The body whorl is moderately inflated, while the spire is well elevated and bears slightly inflated whorls. The surface of the shell is smooth, glossy and unsculptured while the interior is opaque, white and non-pearly. The shell bears a prettily marked pattern of colouration. It is brownish, or brownish red, encircled by somewhat widely spaced, fine, conspicuous coloured spiral lines, each of which is made up of alternate segments of white and dark brown ; these lines are better marked in the larger shells ; again, in each whorl there is a distinct spiral row of dark brown spots or markings immediately below the suture. The smaller shells in the collection have a more finely polished surface and bear more or less distinct, wavy, brownish, transpiral bands. Larger shells of this species collected from Ceylon are also represented in the collection and afforded material for comparison. No live specimen has yet been collected. Krusadai and Shingle Islands.

SERIES NERITACEA.

Family NERITIDAE.

The shell is thick, with a large, rounded, inflated body whorl and a very low, often depressed spire, the internal walls of which are usually absorbed. An umbilicus is absent. The columellar margin is richly callous and flattened, its surface being often tuberculated or ridged. The operculum is generally calcareous, with an internal appendage.

Two genera, *Nerita* and *Neritina* are represented ; in the former, which is exclusively marine, the shell is moderately large and thick, and the columellar surface is usually ridged or tuberculated ; in the latter, which is more or less backwater in habit, and species of which occur commonly on the mud flats at Kundugal, the shell is much smaller and thinner, with a smooth columellar surface.

Genus **Nerita** Linné, 1758.

The shell is thick, ovately rounded, as a rule with a very low spire and abruptly inflated body whorl. The columellar surface is wide, flat and callous, often with wrinkles or tubercles, its straight inner margin being usually toothed, often strongly so. The outer lip of the sperture is abnormally thick and usually more or less finely toothed at its inner edge.

Eight species from the Pamban area are represented in the collection. They may be distinguished as follows :—

1. Columellar surface entirely smooth and more or less polished, but its inner edge adjoining the aperture often toothed ; spire always completely depressed, and on a level with the enlarged body whorl, inner edge of thickened outer lip smooth 2

— Columellar surface, though often polished and glossy, never absolutely smooth, traversed by irregular ridges or wrinkles which are either short and confined to a small portion of the surface, or large, extending transversely throughout the surface, and sometimes even tuberculated ; spire either on a level with the body whorl or slightly raised above it ; inner edge of thickened outer lip almost always toothed, though in worn shells the teeth may be indistinct 3

2. Shell large, with fine transpiral striae (which may sometimes be ill defined) throughout the surface of the body whorl ; callus deposit on columellar surface very thick and extending beyond the level of the suture between the body whorl and the spire ; (width of the columellar surface and thickness of the outer lip generally considerably reduced, and consequently the size of the aperture enlarged in worn shells washed up on the beach) ; common ... ... *N. polita.*

— Shell smaller ; surface of shell traversed by regular, close-set, moderately strong spiral ridges ; callus deposit on columella relatively thin and less extensive, not extending beyond the level of the suture between the body whorl and the spire ; (wearing out of the columellar surface and outer lip less strongly marked in worn shells) ; rare ... *N. dombeyi.*

3. Spire depressed ; surface of shell not sculptured, smooth and even slightly glossy, usually brightly coloured, and enlarged body whorl generally encircled

by broad, widely separated coloured spiral bands ; but colour and colour pattern rather variable ... *N. rumphii.*

— Shell not as above ; spire usually slightly raised, but sometimes depressed ; surface of shell sculptured, never absolutely smooth ; shell as a rule dull-coloured, generally of a mottled greenish brown or uniformly yellowish brown colour ; body whorl not encircled by brightly coloured spiral bands ... 4

4. Spire comparatively well elevated and with pointed apex ; whorls with strongly raised, sharp spiral ribs separated by deeply excavated interstices ; columellar surface with strongly developed ridges, some of which are produced to form strong teeth at the edge adjoining the aperture ; surface of shell uniformly pale greenish or yellowish brown ; outer lip of aperture very strongly toothed ... . *N plicata.*

— Spire depressed and more or less completely immersed in the body whorl, or at most only feebly raised above the level of the body whorl ; apex not pointed ; shell much less strongly sculptured, never with such strong, evenly raised ridges as in the above ; often with mere spiral grooves, or at most with indistinctly raised, blunt, imperfectly separated ridges. Teeth on outer lip of aperture much weaker, more numerous and closely set ... 5

5. Shell sculptured with irregularly developed spiral ridges which are more or less strongly scaly ; columellar area more or less concavely depressed, finely tuberculated in the middle and transversely ridged on the side away from the aperture ... ... *N. squamulata.*

— Spiral ridges on surface of shell, when present, smooth and even, not scaly or coarse-looking ; columellar area simply flattened, not concavely depressed, and generally bearing teeth on the edge adjoining the aperture 6

6. Shell large, uniformly spirally grooved throughout, the grooves being separated by flat, moderately broad interspaces ; columellar area slightly wrinkled in the middle, with one or two strong, stout teeth on the edge adjoining the aperture ; surface of columella smooth on the side away from the aperture ; outer lip of aperture very finely crenated ... . *N. maura.*

— Shell smaller, more or less distinctly spirally ridged, columellar area usually more strongly sculptured with transverse ridges and tubercles ; teeth on the edge of the columella adjoining the aperture thinner and more numerous ; outer lip of aperture with stronger, less numerous and more widely set teeth, and usually with one or two strongly marked, stout lateral teeth at each end of the series ... 7

7. Shell very thick, with an unusually strongly thickened outer lip ; spire so low and depressed as to scarcely reach the level of the upper end of the outer lip, so that the spire is almost obsolete, the enlarged and predominating body whorl consequently becoming more or less bilaterally symmetrical , columella inclining only gradually inwards and tuberculated throughout or at least on the inner part of its exposed surface ; but neither this part nor the inside of the outer lip ever definitely ridged ... . *N. albicilla.*

— Shell not quite so thick, and outer lip of aperture less strongly thickened ; spire imperfectly depressed and slightly exserted above the level of the upper extremity of the outer lip, so that it is distinctly, though slightly elevated above the body whorl ; body whorl more or less obliquely inclining and not strictly bilaterally symmetrical[1] ; columellar surface inclining more steeply inwards and its outer, and sometimes less conspicuously, its inner border and the inner surface of the outer lip are ridged, the tubercles being few and confined to the middle part of the columellar surface . . . . *N. chameleon.*

[1] This difference readily becomes apparent especially when a long series of shells of *N. albicilla* is compared with a similar one of *N. chameleon.*

Nerita albicilla Linné.

Plate III, fig. 6.

Nerita albicilla, Linné, Syst Nat , Ed. X, 1758, p. 778, No 640.
Nerita albicilla, Chemnitz, Conch. Cab., V, 1840, p. 313, pl cxcm, fig 2000.
Nerita albicilla, Reeve, Conch Icon , IX, 1855, *Nerita*, pl xv, fig. 64.
Nerita albicilla, Watson, " Challenger," Zoology, XV, 1886, Gastropoda, p 132.
Nerita albicilla, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 3.
Nerita albicilla, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No. 2, 1942, p. 18.

This is by far the commonest species of *Nerita* occurring in the Pamban area. The shell may be readily distinguished from those of all other species recorded here by the strongly marked depression of the spire, which is so low as to scarcely reach the upper extremity of the outer lip, the triangularly ovate profile of the shell, and by the almost perfect bilateral symmetry of the body whorl. The surface of the shell is closely spirally ribbed, the ribs slightly diverging fan-wise towards the somewhat expanded outer edge of the body whorl. The columellar surface is finely tuberculated throughout, and there is no trace of regular ridges or wrinkles ; the inner edge of this surface is finely toothed in the middle. The inner margin of the abnormally thickened outer lip bears fine and close-set ridges. The colour is very variable , usually it is whitish, irregularly blotched with dark grey or greenish black ; the interstices between the ribs are sometimes marked by reddish spiral lines. Living specimens are considerably plentiful on the reefs where they are often found attached to, or crawling slowly on, blocks of stone and dead coral, particularly when these are exposed during the low tide. Pamban, Krusadai and Shingle Islands.

Nerita chameleon Linné.

Plate III, figs. 7*a* and 7*b*.

Nerita chameleon, Linné Syst. Nat , Ed. X, 1758, p 779, No 644
Nerita stella, Chemnitz, Conch. Cab , XI, 1850, pl 197, figs 1907 and 1908
Nerita stella, Reeve, Conch Icon., IX, 1855, *Nerita*, pl. xiii, fig 60.
Nerita chameleon, Watson, " Challenger, " Zoology, XV, 1886, Gastropoda, p. 132.
Nerita (Theliostyla) chameleon, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 4
Nerita chameleon, Gravely, Bull Mad. Govt. Mus (Nat. Hist.), V , No. 2, 1942, p. 18.

This species, though less common than the preceding one, is well represented at Krusadai, and both dead shells and live specimens have been collected. The shell resembles very much that of *N. albicilla*, but the spire is very distinctly, though slightly, raised above the level of the body whorl. The shell is spirally ribbed, but the ribs are less regularly developed, somewhat sharper, better defined and slightly narrower than those of *N. albicilla*. The columellar surface is traversed by transverse ridges on the inner and outer borders, while the tubercles are confined to the central portion of the surface between these sets of ridges. The ridges away from the aperture are stronger and much larger than the ones adjoining the aperture. The outer lip is toothed within as usual. The shell is yellowish white or white,

variegated with dark green. Occasionally the shell may bear broad, dark green spiral bands. Krusadai and Shingle Islands.

There were a few specimens in Mr. Crichton's collections wrongly labelled as *N. bisecta* and *N. fulgerens.* But they were later sent to Mr. Winckworth who has referred them all to the present species.

Considering the fact that this and the preceding species are the sole representatives of the genus recorded from Madras, it would appear that the Pamban area is relatively rich in Neritids.

Nerita polita Linné

Plate III, figs. 8*a* and 8*b*.

Nerita polita, Linné, Syst Nat, Ed. X, 1758, p 778, No. 638.
Nerita polita, Reeve, Conch. Icon, IX, 1855, *Nerita*, pl 1, fig 2
Nerita polita, Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, 1906, p 617.
Nerita polita, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 7

The shell is markedly larger in average size than in either of the two preceding species. At first sight the surface of the shell appears practically smooth, but on closer examination it is seen to be finely transpirally straited. The body whorl is large and strongly inflated, with its upper part somewhat flattened. The spire is more or less completely depressed, almost obsolete, its position being indicated by a small spirally coiled line representing the suture. The marginal surface of the oulter lip is smooth, polished and scarcely toothed ; and the broad, exposed surface of the columella is covered by a markedly thick and extensive deposit of callus, the surface of which is smooth and more or less glossy for the most part, but its border adjoining the aperture is often crudely toothed in the middle. The shell is generally dull whitish, variously marked with greyish green patches ; sometimes there is a well defined, broad, dark grey spiral band immediately below the suture. Worn shells washed up on the beach are usually bleached milk-white, and have the columellar surface and outer lip of aperture thinned down considerably, the aperture becoming wider and the teeth at the inner edge of the columella disappearing consequently. Living specimens are particularly common on the reefs on Pulli and Shingle Islands, where large numbers of them are found attached to rocks exposed at low tide. Pulli Reef, Krusadai and Shingle Islands.

Nerita plicata Linné.

Plate III, figs. 9*a* and 9*b*.

Nerita plicata, Linné, Syst Nat, Ed X, 1758, p 779, No. 642.
Nerita plicata, Reeve, Conch Icon, IX, 1885, *Nerita*, pl ix, fig 42.
Nerita plicata, Smith, in Gardiner's Fauna and Georgaphy of the Maldive and Laccadive Archipelagoes, II, 1906, p 617.
Nerita plicata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 6.

This species may at once be distinguished from all other species of Neritids recorded in this paper, by the presence of strongly developed, raised, spiral ribs on the surface of the shell, separated by deep, well excavated interstices and by the spire being relatively strongly raised and clearly exserted beyond the level of the large, globular body whorl, and by the apex being more pointed and sharply defined. The outer lip of the aperture is thick, and its inner margin bears very strong, stout teeth of which the outermost ones are by far the largest and nodule-shaped. The columellar area which bears a deposit of callus, is somewhat convex and dips rather steeply inwards towards the aperture. Its surface bears large, strong, transversely elongated wrinkle-like ridges, some of the stouter ones of which are produced to form strong, widely set teeth at the edge adjoining the aperture. The shell is generally uniformly pale greenish or yellowish brown, but may sometimes be marked with rows of dark spots. Living specimens are not uncommon on the reefs. Krusadai and Shingle Islands.

Nerita maura Récluz.

Plate III, figs. 10*a* and 10*b*.

Nerita maura, Récluz, Rev. Zool. Soc. Cuvierienne, 1841, p 104.
Nerita maura, Reeve, Conch Icon., IX, 1855, *Nerita*, pl. IV, fig. 17.

The shell is large and resembles that of *N. polita* in shape and proportions. The spire is low and depressed. The body whorl is large, but somewhat compressed on the side away from the aperture. The surface of the shell is uniformly traversed by shallow, close-set spiral grooves, the interstices between these grooves being flattened, and not raised into definite ridges. The outer lip of the aperture is greatly thickened and its inner edge bears a few crudely developed wart-like tubercles towards its inner edge, but the greater part of it is more or less smooth ; its inner margin adjoining the aperture, however, is deeply denticulated in the middle. The shell is greyish black, profusely dabbed with white all over; the columella and the marginal surface of the outer lip are white and glossy. Only dead shells have been collected. Pamban and Shingle Island.

Nerita rumphii Récluz.[1]

Plate III, figs. 11*a* and 11*b*.

Nerita rumphii, Récluz, Rev Zool Soc. Cuvierienne, 1841, p. 147
Nerita rumphii, Reeve, Conch. Icon, IX, 1865, *Nerita*, pl XIV, fig. 62.
Nerita polita var rumphii, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 7.

This species is closely related to *N. polita*, and has been treated by Schepman as a variety of that species. The shell may, however, be readily distinguished from that of *N. polita* as a rule by its brighter, more attractive colouration and concavely depressed columellar surface.

[1] Mr. Winckworth suggests that this species might possibly prove to be a colour variety of *Nerita polita*.

The shell is moderate-sized, with a practically smooth and even glossy surface, though on close examination it is seen to be very finely transpirally striated. The columellar surface is slightly concavely sunk and feebly ridged or granulated in the middle, and its margin adjoining the aperture is beset with two or three weakly developed teeth. The outer lip is thickened and its marginal surface slopes steeply inwards, its inner edge being faintly crenulated. This species is reported to be extremely variable in its colouration, Reeve figuring not less than eleven distinct colour varieties. In the Museum collection three types are represented, but they conform to a single pattern made up of three coloured spiral bands : (*a*) dark grey, freckled with brownish markings, spiral bands reddish ; (*b*) light pink, spiral bands somewhat narrow, ashy black, freckled with white ; (*c*) dull reddish, spiral bands of the same colour as in type (*b*) but broader. Pamban.

Nerita squamulata Le Guillou.

Plate III, fig. 12.

Nerita squamulata, Le Guillou, Rev. Zool. Soc. Cuvienènne, 1841, p. 344.
Nerita squamulata, Reeve, Conch. Icon , IX, 1855, *Nerita*, pl xv, fig 63
Nerita chameleon var. squamulata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 4.

This species approaches *N. chameleon* in shape and proportions of the shell and is treated by Schepman as a variety of that species. It is represented in Mr. Crichton's collections by two somewhat worn shells from Pamban. The spire is only slightly raised above the level of the body whorl. The shell is spirally ridged, much as in *N. chameleon*, but the ridges are distinctly beset with blunt, scaly processes, which, however, have almost disappeared from the worn out portions of the shells examined. The columellar surface is concavely depressed, toothed at the margin bordering the aperture, irregularly ridged on the side away from the aperture and finely tuberculated in the middle. The teeth on the inner edge of the outer lip are markedly elongate and fairly close-set. The colour is variable. Of the two shells in the collection, one is pale greenish brown, spotted with orange, and the other greenish white, with greyish black markings. Pamban.

Nerita dombeyi Récluz.

Plate III, figs. 13*a* and 13*b*

Nerita dombeyi, R'cluz, Rev Zool. Soc Cuvienènne, 1841, p. 149.
Nerita dombeyi, Reeve, Conch Icon., IX, 1855, *Nerita*, pl xvii, fig 71.

A single shell of this species is represented in Mr. Crichton's duplicate collections. It is moderately small, with a depressed spire and obliquely enlarged body whorl, the upper part of which is more or less flattened. The surface is traversed by narrow, close-set spiral ridges, some of which, especially in the upper part of the shell, are weaker, and alternate with the stronger ones. The entire lower or basal surface of the shell (i.e., the columellar area and the marginal surface of the outer lip of aperture) is smooth and highly polished.

The teeth at the inner margin of the columellar surface are very feebly developed. The outer lip is not toothed within. The shell is more or less uniformly dark bluish grey, but the interstices between the ridges are paler. Pamban.

Of the species of *Nerita* enumerated above, the first four are represented both by dead shells and spirit specimens with their soft parts preserved intact, and are the common ones which the collector is likely to come across far more frequently than the last four, which are rarer, and are represented in the collection by only a very limited number of dead shells.

Genus **Neritina** Lamarck, 1816.

The shell is as a rule smooth, ovoid, with an inflated body whorl, and proportionately minute spire. The columellar surface is flattened and smooth. The operculum is calcareous and bears a sharp lateral appendage.

Two species, *N. oualaniensis* and *N. rangiana* are recorded from Pamban. Of these two species, the former, which has also been recorded from the Madras area, is by far the commoner, and may be readily distinguished from the latter by the shell being considerably larger and the body whorl being less markedly elongate and more globularly rounded ; it also displays a wider range of variation in its colour pattern.

Neritina oualaniensis Lesson.

Plate IV, figs. 1*a* and 1*b*.

Neritina oualaniensis, Lesson, Voy Coquille, Zoologie, II, 1831, p 379
Neritina ualanensis, von Martens, Conch Cab , Ed II, 1878, *Neritina*, p 193, pl. 20, figs. 1—24.
Neritina oualanensis, Reeve, Conch Icon , IX, 1855, *Neritina*, pl xxxvi, fig 168.
Neritina ualanensis, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 13
Smaragdia oualaniensis, Crichton, Journ Bomb Nat Hist Soc , XLII, 1941, p 340
Neritina (*Smaragdia*) *oualaniensis*, Gravely, Bull Mad Govt Mus. (Nat Hist), V, No. 2, 1942, p. 18.

This species is very well represented in the Pamban area, especially in localities somewhat far removed from the open sea. The shell is small, ovoid, with a smooth, polished surface, a very small spire and a comparatively large, inflated body whorl ; the whorls of the spire are very imperfectly developed, almost obsolete. The columellar area is covered by a thin callus layer the surface of which is almost perfectly smooth. In some shells the edge of the columellar surface adjoining the aperture may be finely serrated. The aperture is moderately large, and its outer lip is thin, unlike that of *Nerita*, and smooth within. The operculum is a calcareous, D-shaped plate with a brownish margin and an apophysis (projecting appendage). The shell is generally yellowish white or bluish white, profusely ornamented with olive green lines and markings, but the pattern of colouration varies widely, and the following are some of the more common types found among shells from Pamban :—

(*a*) Almost uniformly marked throughout the surface with very fine, close-set, slightly wavy, transpiral lines ; these lines may sometimes be more widely separated here and there, giving rise to small triangular islets of the ground colour.

(*b*) The triangular patches may be larger, more numerous and distributed throughout the surface, confining the transpiral lines to the small interstices between them.

(*c*) Some of these triangular spaces may be specially enlarged and concentrated into distinct spiral bands.

(*d*) The enlarged triangular patches may be transversely elongated and take the form of arrow-heads telescoping into one another and arranged linearly to form spiral bands. The edges of these patches may sometimes be red in types *b*, *c* and *d*.

(*e*) Three clear, yellowish white or bluish white spiral bands each bordered above and below by blackish lines, the interspaces between the bands being traversed by minute, extremely close-set transpiral lines.

(*f*) The clear spiral bands may be narrower, being reduced to thin lines, and the zones of transpiral lines wider.

Various intergradations between these types may be found to occur in any large series of shells collected from a particular locality.

Living specimens of this species are abundant on the mud flats at Kundugal Point, especially in certain particularly shallow areas infested with weeds, and in the surface layers of mud at Bushy Point on Krusadai Island, where the water is somewhat brackish ; numerous specimens have been collected from both these localities.

Neritina rangiana Récluz.

Neritina rangiana, Récluz, Rev. Zool Soc Cuvierienne, 1841, p 339.
Neritina rangiana, Reeve. Conch Icon., IX, 1856, *Neritina*, pl xxxi, fig 142

This species is comparatively rare at Pamban, and is represented in the Museum collection only by a few dead shells. The shell is much smaller and thinner than in the preceding species, and the body whorl is somewhat depressed and of a peculiar, elongately ovate shape; its upper part adjoining the small, feebly exserted spire is more or less flattened. The columellar surface is smooth and bears a thin deposit of callus. The shell is pale green marked with fine, oblique, transpiral, dark-coloured lines which are few and widely separated on the spire and upper portion of the body whorl, leaving large, clear spaces of the ground colour, and far more numerous, finer and close-set on the lower three quarters of the body whorl, but still leaving three more or less distinct spiral bands made up of small, clear, triangular patches of the ground colour. The surface is smooth and polished. All the shells in the collection conform to the pattern of colouration outlined above. Pamban.

Family PHENACOLEPADIDAE.

The shell is symmetrical and cap-shaped, with a wide, ovate aperture and a strongly curved apex. An operculum is absent. The shell is generally elegantly sculptured.

A single species, belonging to the genus *Phenacolepas* has been recorded.

Genus **Phenacolepas** Pilsbry, 1891.

(Syn. **Scutellina** Gray, 1847)

The cap-shaped shell is moderately depressed and arched, white or brownish. The apex of the shell is sometimes situated more towards the middle, but usually nearer the hind margin, or even directly above it. The shell is sculptured as a rule with radial ribs.

Phenacolepas asperulata (Adams).

Plate IV, figs. *2a* to *2d*

Scutellina asperulata, H & A Adams, Genera of Recent Moll, I, 1854, p. 461.
Scutellina asperulata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 15.
Phenacolepas asperulata, Thiele, Conch Cab, 1909, *Phenacolepas,* p. 32, pl v, fig. 9.

Numerous dead shells are frequently found washed up on the beach on Krusadai Island, and several of them are represented in the collection, but no live specimen has yet been collected. The shell is moderately small, thin, white, cap-shaped, somewhat resembling that of a *Patella,* the spire being absent, but definitely more deeply vaulted. The apex of the shell is pointed, curved strongly backwards and is situated very close to the hind margin, often almost vertically above it. The arched outer surface of the shell bears fine, close-set ribs radiating from the apex ; each of these ribs is minutely transversely ridged, this feature being seen distinctly under the lens when fresh shells are examined ; these minute transverse ridges are more pronounced in the short, concavely excavated area directly below the curved apex. The interstices between the radial ribs are smooth, but some of them are traversed by secondary ribs which are weaker than, and alternate with, the principal ribs ; the secondary ribs extend only a short distance upwards from the margin, and do not reach the apex. The aperture is large, and the profile of its margin broadly ovate. The interior of the shell is smooth, translucent white and slightly glossy ; the impression of the mantle is seen as an opaque white line on the inner surface. Most of the specimens in the collection are white, but a few are pale yellowish brown, and one or two shells show traces of a dark brown epidermis in the interstices between the ribs. The shells are, on an average, about 13 mm. long, 10 mm. wide and 5 mm. high. Krusadai Island.

Order Megagastropoda.

SERIES LITTORINACEA.

Family LITTORINIDAE

The shell is of variable shape, generally with a rounded, inflated body whorl and a well-developed, elevated spire. The operculum is horny and bears widely separated whorls. This family includes both marine and terrestrial snails popularly known as winkles.

A single genus, *Littorina*, is represented at Pamban.

Genus **Littorina** Férussac, 1821.

The shell is higher than broad, with more or less rounded whorls. The aperture is ovate and its margin rather thin and unbroken by canals. The operculum is horny, with two whorls.

The three Krusadai species of *Littorina* may be recognized as follows :—

1. Lower third of the body whorl more or less sharply and angularly marked off from its upper two-thirds, the line of separation between these two parts being usually marked by a distinct, raised, spiral ridge which commences at the upper extremity of the outer lip. Uniform spiral striation always present throughout the surface. Shell as a rule of a dark mottled brownish colour ... ... *L. scabra.*

— Lower portion of the surface of the body whorl more evenly rounded and not angularly marked off from the upper portion as above ; sculpture and colouration variable 2

2. Shell usually whitish, with pale, dark or purplish brown transpiral wavy markings which may sometimes coalesce to form a more or less reticulated colour pattern of brown and white patches ; sometimes uniformly horny brown. Shell generally smooth, sometimes with faint spiral grooving ... ... *L. undulata.*

— Shell smaller, with a relatively short spire, and distinct, slightly irregular, semigranular spiral ridges, one of these at a short distance below the suture being particularly well marked and rendering this portion of the whorls slightly angular ; colour brownish or greyish brown, with spiral rows of white spots confined mainly to the semigranular spiral ridges ... ... *L. subgranosa s. str.*

All these species are recorded from Madras, which is decidedly richer in Littorinida than the Pamban area.

Littorina scabra Linné.

Plate IV, figs. 3*a* and 3*b*.

Littorina scabra, Linné, Syst. Nat., Ed. X, 1758, p. 770, No. 584.
Littorina scabra, Reeve, Conch. Icon., X, 1858, *Littorina*, pl. v, fig. 21.
Littorina scabra, Weinkauff, Conch. Cab., Ed. II, Vol. II, 1878, *Littorina*, p. 37, pl. *iv*, figs. 7—10, 12, 16—18.
Littorina scabra, Tryon, Man. Conch., IX, 1894, p. 243, pl. 42, figs. 18—20.
Littorina scabra, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 193.
Littorina scabra, Crichton, Journ. Bomb. Nat. Hist. Soc., XLII, 1941, p. 341.
Littorina scabra, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 20.

This is by far the commonest species of *Littorina* recorded from Krusadai. Large numbers of living specimens of this species are frequently found attached to the stems and leaves of the swampy bushes growing out into the sea at the water's edge on the southern side of Bushy Point on Krusadai Island and also on the stems of similar bushes fringing the shore line on the southern extension of the Island leading to the Pulli reefs. The animals are found at such considerable heights above the level of sea water that it seems improbable that they get more than slightly wetted by spray during high tide ; their colour usually harmonises admirably with that of the bark of the stem on which they rest. When collected and left in a basin of sea water, they always climb out above the level of the water as far high as they can reach, for they have become more or less perfectly adapted to aerial respiration. They may be successfully narcotised by asphyxiating them for twenty-four hours in a stoppered bottle full of sea water.

The shell is moderately large, generally attaining a length of 1 inch to 1·2 inch though it is by no means uncommon to find much smaller specimens measuring half an inch in length or even less, living side by side with the larger ones. The whorls are inflated and the spire is considerably elevated, with a sharply pointed apex. The body whorl, as already remarked in the key above, is more or less sharply angular below, the angular part being marked by a slightly raised, sharp spiral ridge. The surface of the whorls is uniformly and finely spirally grooved throughout. The colour of the shell is rather variable : it is generally of a dark mottled brownish colour ; the darker brown spots usually tend to be aggregated to form transpirally elongated oblique patches, which are sometimes well marked only near the sutures and the angular part of the body whorl, but sometimes extend more or less throughout the surface. Pamban and Krusadai Island.

Littorina undulata Gray.

Plate IV, figs. 5*a* and 5*b*.

Littorina undulata, Gray, Zool. Beechey's Voyage, 1839, p. 140.
Littorina undulata, Reeve, Conch. Icon., X, 1857, *Littorina*, pl. xiii, fig. 67.
Littorina undulata, Weinkauff, Conch. Cab., Ed. II, Vol. II, 1882, *Littorina*, p. 73, pl. ix, figs. 15 and 16.
Littorina undulata, Tryon, Man. Conch., IX, 1894, p. 244, pl. 43, figs. 39 and 40.
Littorina undulata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 194.
Littorina undulata, Crichton, Journ. Bomb. Nat. Hist. Soc., XLII, 1941, p. 337.
Littorina undulata, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 20.

This and the following species which were long unrecorded from the Pamban area are now represented in the collection by a few dead shells from Pamban obtained fairly recently ; four of these belonging to this species are from Mr. Crichton's duplicate collections The shell of *L. undulata* is generally smaller than that of the full-grown *L scabra* and the body whorl and base of spire are relatively narrow ; further, the body whorl is evenly rounded and not sharply angular below as in the preceding species. The shell presents considerable variation in sculpture and colouration. The surface is sometimes smooth, but more often it is very finely and uniformly spirally grooved, the grooved shells being usually dark purplish brown in colour ; but occasionally pale-coloured shells may also show fine spiral grooving ; the colour is generally whitish or very pale yellowish brown, conspicuously marked with zig-zag, transpirally extending brownish patches ; sometimes the shell is uniformly pale horny brown throughout, this type being represented among Mr Crichton's specimens ; the columella is often violet and the interior of the aperture brown or white. Pamban.

Littorina subgranosa (Dunker)

Plate IV, fig 4.

Melarhaphe subgranosa, Dunker, Verhandl, K K. Zool -Bot Ges , XVI, 1886, p 913.
Littorina subgranosa, Frauenfeld, Reis. Ost Freg Novara, Zool Moll., (3) II, 1867, p. 9, pl. 1, fig. 10.
Littorina subgranosa, Gravely, Bull Mad Govt Mus. (Nat Hist), V, No 2, 1942, p 20

The shell is smaller than in either of the two preceding species ; the body whorl is broad and the spire relatively short. The surface of the shell is traversed by fine, semigranular spiral ribs, some of which are stronger than the others; but one of them a short distance below the suture is usually more pronounced and strongly raised than the rest, thereby rendering this portion of the whorl somewhat angular The columellar surface is rather broad in proportion to the size of the shell. The body whorl is pale brownish or almost whitish, with distinct white spots which are chiefly confined to the spiral semigranular ribs. The spire is as a rule much darker in colour and the rows of spots on its surface are not well defined. The columellar area is pale brown and the interior of the aperture dark chestnut. Pamban.

The form just described is *Littorina subgranosa s. str.*, and is represented in the collection by six dead shells from Pamban. It is not certain whether the varieties ***eudeli*** and ***novae-zeylandiae*** which are recorded from Madras occur also at Krusadai ; probably they do occur, for one rather worn, moderately large shell from Pamban, with a violet columells appears to agree fairly well with Reeve's figure and description of the latter (Reeve, Conch. Icon., X, 1857, *Littorina*, fig. 74) and two very dark-coloured shells from Pamban with somewhat corroded surface and indistinct sculpture seem referable to the former variety.

SERIES RISSOACEA.

Family RISSOIDAE.

The shell is usually very small, ovately conical, sometimes cylindrical or turretted; smooth or variously sculptured ; the aperture is rounded or ovate, sometimes with a hollow in the lower margin ; the operculum is with or without an internal appendage.

A single genus, represented by three species, is recorded from Krusadai.

Genus **Rissoina** Orbigry, 1840.

The shell is turretted and usually colourless ; the whorls are ribbed, and the columellar border oblique. The aperture is semicircular, and the operculum is thick and provided with an internal appendage, somewhat as in *Neritidae*.

The Pamban species of *Rissoina* may be distinguished with the aid of the following key :—

1. Shell not minute, comparatively large, with considerably elongated spire; whorls of the spire numbering about ten ; profile of shell elongately conical, and more or less strictly straight-sided ; apex of spire sharply pointed ... ... *R. clathrata.*

—Shell much smaller with less markedly elongated spire ; whorls of spire numbering not more than about seven , profile of shell rather ovately conical, the sides of the shell being more rounded and its apex less sharply pointed 2

2. Shell moderately elongate, whorls somewhat strongly inflated and exhibiting a slight gloss on the surface ; sculpture consisting principally of strong transpiral ribs, spiral sculpture being practically absent, or at most represented by very fine, close-set spiral striae ... . *R. bertholleti.*

—Shell shorter and stouter, whorls less markedly inflated and surface of shell not glossy ; sculpture consisting of both transpiral and spiral ridges which are almost equally strong and regularly retriculate to form a strongly latticed pattern, the meshes of the network forming small, depressed pits ... ... *R. media.*

Rissoina clathrata A. Adams.

Plate IV, figs. 6*a* and 6*b*.

Rissoina clathrata, A. Adams, Proc. Zool. Soc London, 1851, p 265
Rissoa clathrata, Reeve, Conch Icon., XX, 1878, *Rissoa*, pl ix, fig 76.
Rissoina clathrata, Nevill, Handlist of Mollusca, Ind. Mus, pt ii, 1884, p. 86, No. 55.
Rissoina clathrata, Gravely, Bull Mad Govt Mus. (Nat Hist), V, No 2, 1942, p. 21.

This is the commonest species of *Rissoina* taken at Pamban, and has been recorded also from the Madras area. A number of dead shells are represented in the collection and the largest among them are fully over a centimetre in length. The shell is rather slender with a tall, somewhat straight-sided spire which bears numerous whorls. The whorls are slightly inflated. The body whorl bears beside the columella a deeply excavated groove, beneath which is a particularly strong spiral rib. The body whorl is traversed by about six (including the strongly marked rib at the base) and each of the remaining whorls by about three spiral ridges ; in all the whorls these are decussated by numerous equally strong transpiral ridges, the points of intersection of the spiral and transpiral ridges being somewhat nodularly elevated. The meshes of the lattice-like sculpture thus formed are represented by deep, squarish depressions. The outer lip is markedly thickened, slightly prolonged anteriorly, and the hollow on its lower margin is deep and well defined. The aperture is ovate. The shells are mostly whitish throughout, but a few bear a greyish violet tinge on the outer surface. There is also a small specimen which is not quite typical, and is regarded by Mr. Winckworth as probably a half-grown specimen of the species. Pamban.

Rissoina media Schwartz

Rissoina media, Schwartz von Mohrenstern, Denkschr. Acad. Wiss Wien, XIX, 1860, *Rissoina*, p. 92, pl. vii, fig 56
Rissoina media, Watson, " Challenger ", Zoology, XV, 1886, Gastropoda, p 621.
Rissoina media, Weinkauff, Conch Cab, 1880, *Rissoina*, p 38, pl xi, fig 5.
Rissoina media, Tryon, Man. Conch, IX, 1887, p. 382.
Rissoina media, Nevill, Handlist of Mollusca, Ind. Mus, pt ii, 1885, p 84.

This species is nearly as common as the preceding one at Pamban, and many dead shells are represented in the Museum collection. The shell is much smaller, being scarcely about a quarter of an inch in length, with stouter and less markedly elongated spire which bears fewer whorls and has a more rounded outline. The whorls are less strongly inflated. The sculpture is more or less latticed as in the preceding species, being composed of intercrossing spiral ridges and transpiral ribs, and the points of intersection being slightly raised and nodular, but as a rule, the transpiral sculpture predominates, the spiral ridges being weaker, finer and more numerous. The aperture is ovate as in *R. clathrata*, but the hollow on ite lower margin is relatively shallow. The shells are all uniformly white. Pamban.

Rissoina bertholleti Issel.

Plate IV, fig 7.

Rissoina bertholleti, Issel, Malac Mar Rosso, 1869, p 208.
Rissoina berthelotı (misspelt), Nevill, Handlist of Mollusca, Ind. Mus , pt ii, 1884, p. 78.
Rissoina bertholleti, Fischer, Journ de Conchyl , XLIX, 1901, pl. iv, figs 5 and 6

This species is relatively rare at Pamban, and is represented by a single specimen in the collection. The shell is somewhat larger than in *R. media*, and moderately slender and elongated. The surface is slightly glossy. As in *R. clathrata*, the whorls are more or less inflated, and there is a strong, groove-like spiral depression towards the base of the body whorl beside the columella, the part below this groove being marked off as a stout, rib-like thickening. The sculpture consists mainly of elegant, strong, raised and rather widely separated transpiral ribs which are crossed by numerous, very fine, close-set spiral striae. The aperture is ovate with a strongly thickened outer lip, the hollow on the somewhat produced anterior margin of which is well defined. The shell is uniformly white throughout. Pamban.

SERIES CERITHIACEA.

Family TURRITELLIDAE.

The shell is generally large and thick, without an umbilicus, often very tall and comparatively slender, with more or less numerous whorls, and usually with spiral sculpture ; the aperture is small, rounded, or angular, and its margin unbroken by canals ; the outer lip is usually distinctly and broadly sinuate. The operculum is horny. There is no siphon ; the foot is broad and truncated. This family includes the familiar, elongated turret shells.

A single genus, *Turritella*, is included in this family, and is represented at Krusadai by two species.

Genus **Turritella** Lamarck, 1799.

The characters are the same as those of the family.

Two species, *T. acutangula* and *T. attenuata* are recorded from Krusadai ; the latter may be readily distinguished from the former by the shell being of a more slender, elongated and attenuated form and by the spiral ridges on the whorls being weaker.

Turritella acutangula (Linné).

Plate IV, fig. 8.

Turbo acutangulus, Linné , Syst Nat , Ed X, 1758, p 766
Turritella duplicata, Lamarck, Anim. sans vert , (Deshayes' edit), IX, 1843, p. 251.
Turritella duplicata, Reeve, Conch. Icon , V, 1849, *Turritella*, pl 1, fig. 2
Turritella duplicata, Hornell, *Common Molluscs of South India, Mad Fish. Bull.*, XIV, 1921, p. 112.
Turritella duplicata, Crichton, Journ Bomb Nat. Hist Soc., XLII, 1941, p. 339.
Turritella acutangula, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 22.

Though both this species and the next are known to be common on most South Indian shores, the present species appears to be much the commoner of the two in the Pamban area, and a number of specimens (but mostly empty shells) have been collected, especially from the mud flats at Kundugal Point, where they are found strewn on the surface or half-buried in the sand. The length of the shell is fully about three times the maximum width of the body whorl. The whorls are markedly bulged in the middle, and the surface is finely striated spirally, but about the middle of each whorl there are two more or less strongly raised spiral ridges, and very often there may also be one or two additional raised striae above and below them ; these secondary striae, though much less pronounced than the strong median ridges, may still be readily distinguished from the finer and more numerous spiral striae. The columellar margin of the aperture is covered with a whitish, polished callus deposit. The shell is pale yellowish brown for the most part, but the upper halves of the whorls generally tend to be darker. A few live specimens have also been collected, mostly from sandy areas. Krusadai Island, Kundugal Point and Pamban.

Turritella attenuata Reeve.

Plate IV, fig. 9.

Turritella acutangula, Lamarck, Anim. sans vert, (Deshayes' edit), IX, 1843, p 259 (non *Turbo acutangulus* Linné).
Turritella attenuata, Reeve, Conch Icon, V, 1849, *Turritella*, pl 1, fig 4.
Turritella attenuata, Gravely, Bull. Mad Govt Mus (Nat. Hist), V, No. 2, 1942, p. 22.

As the specific name suggests, the shell is comparatively slender and considerably more elongated than in the preceding species, its height being at least four times as much as the maximum width of the body whorl The whorls are more conspicuously bulged in the middle, and the sutural constrictions consequently appear deeper. The surface is traversed by fine spiral striae as well as by strongly raised spiral ridges, but the latter are, as a rule, more numerous than in the previous species, and are disposed differently , the strongest rib occurs somewhere near the middle and is followed above by a series of ribs which get successively weaker, and below by another raised rib nearly as strong as the median one and separated from it by a rather wide interval. The shell is brownish, but more often tends to be more or less strongly tinged with blue. Kundugal Point and Pamban

Family ARCHITECTONIDAE (= SOLARIIDAE).

The shell is depressly cone-shaped, with a flattened base and a widely open umbilicus which is deep and extends nearly to the top of the spire ; the umbilicus bears a toothed margin, and from its resemblance to a winding staircase, these shells are popularly known as staircase shells. The aperture is small, rounded or angular.

Two genera, *Architectonica* and *Torinia* are recorded from Pamban. In the latter the shell is strongly flattened, and more or less top-shaped or disc-shaped, with a depressed apex and evenly arched upper surface, while in the former the shell is definitely conical, with a pointed apex. Both genera are represented only by dead shells in the collection.

Genus **Architectonica** (Bolten) Röding, 1798.

(Syn. **Solarium** Lamarck, 1799).

The shell is thick, solid and shaped like a broad, low cone, with a sharply angular lower edge and flattened basal surface. It is usually sculptured with oblique transverse grooves and spiral ridges. The margin of the umbilicus bears nodular folds.

This genus is represented at Krusadai by two species, *A. laevigata* and *A. perspectiva*. In the latter the spire is more depressed, the sides of the cone-shaped shell are straighter and the flattened basal surface of the shell bears near its inner and outer margin *three* grooves while in the former the spire is more elevated, the sides are more convexly arched and the base bears only *two* grooves near the margins.

Architectonica perspectiva (Linné).

Plate IV, figs. 10*a* and 10*b*.

Trochus perspectivum, Linné, Syst Nat , Ed. X, 1758, p 757, No 503
Solarium perspectivum, Philippi, Martini-Chemn Conch Cab , Ed II, Vol. II, 1859, *Solarium*, p. 27, pl. iv, fig 6 (*incisum*).
Solarium perspectivum, Reeve, Conch. Icon., XV, 1866, *Solarium*, pl. ii, fig 11.
Solarium perspectivum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 218.
Architectonica perspectiva, Gravely, Bull Mad Govt. Mus (Nat. Hist.), V, No. 2, 1942, p. 23.

Several dead shells are represented in the collection. The shell is moderately large and thick with a broad, flattened base and depressly conical spire. The whorls are scarcely inflated and have almost perfectly straight sides The lower edge of the body whorl is sharply angular. The surface is obliquely transpirally striated throughout. There is a distinct spiral rib near the lower edge of each whorl ; that on the body whorl being immediately followed below by a deeply incised, white, thread-like groove ; there is also a well marked spiral groove a little below the suture in each whorl. The basal surface of the shell is finely radiately striated and bears a broad raised marginal band at the periphery with a distinct double spiral groove running on it medially. The umbilicus is very wide, with a strongly plicated margin ; immediately beyond this margin is a strong spiral rib separated off by two deep spiral grooves one on either side ; this rib follows the course of the umbilical margin and runs throughout the extent of the deep umbilicus. The shell is attractively ornamented with bright coloured bands. The ground colour is generally pale brown. The raised band at the bottom of each whorl is spotted alternately with white and dark brown. Immediately below the suture there is a white spiral band bounded above and below by dark brown spiral bands. The

raised marginal band on the basal surface and the umbilical margin are spotted with brown. Pamban.

Architectonica laevigata (Lamarck)

Plate IV, figs. 11*a* and 11*b*.

Solarium laevigatum, Lamarck, Anim sans vert. (Deshayes' edit), IX, 1843, p 98.
Solarium laevigatum, Reeve, Conch. Icon, XV, 1866, *Solarium*, pl 11, fig 9
Solarium laevigatum, Dautzenberg, Journ de Conchyl, LXXVI, 1932, p 62
Architectonica laevigata, Gravely, Bull Mad Govt Mus (Nat. Hist), V, No 2, 1942, p 23.

The shell is more elevated than in *A. perspectiva* and the sides are slightly more rounded. The surface is traversed throughout by regularly spaced spiral grooves. As in the preceding species, there are oblique transpiral striae on the surface of the whorls, and the basal surface is radiately striated, but the teeth on the umbilical margin are stouter and the flattened basal surface bears a raised outer marginal band which is traversed by only a single median spiral groove, and a double spiral groove abutting on the toothed umbilical margin. The shells in the collection are rather worn and are considerably bleached, but traces of yellowish spots are seen especially near the sutures and at the lower edge of the body whorl; the original colour is much brighter. Kundugal Point.

Genus **Torinia** Gray, 1842.

(Syn. **Heliacus** Orbigny, 1842.)

The shell is flatly conical, or more often disc-shaped, more or less widely umbilicated, and as a rule with granular spiral sculpture. The operculum has several, often membranously fimbriated whorls.

Two species, *T. dorsuosa* and *T. fulva* have been recorded from Pamban. The latter is readily distinguished from the former by the shell being much smaller, its upper surface being more strongly flattened, and by the transpiral ribs being stouter and more raised than the decussating weaker spiral ridges.

Torinia dorsuosa (Hinds).

Plate V, figs. 1*a* and 1*b*.

Solarium dorsuosum, Hinds, Proc Zool. Soc. London, 1844, p 23.
Solarium dorsuosa, Philippi, Conch Cab, Ed II, Vol II, 1859, *Solarium*, p 37.
Solarium dorsuosum, Sowerby, Thes Conchyl., III, 1866, pl. ccliv, figs. 73 and 74.
Torinia dorsuosa, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 221
Torinia dorsuosa, Dautzenberg, Journ de Conchyl, LXXVI, 1932, p. 63
Torinia dorsuosa, Lamy, ibid, LXXXII, 1938, p 139
Heliacus dorsuosus, Gravely, Bull. Mad. Govt Mus. (Nat. Hist), V, No. 2, 1942, p 23.

Two dead shells from Pamban are represented in the collection. The shell is flattened, almost, disc-like and not much unlike that of a small *Umbonium* in shape and appearance,

the whorls of the spire being depressed, but the upper surface is slightly convexly arched, the entire shell assuming more or less the shape of a lenticular, biconvex disc. The surface is strongly spirally ribbed, the ribs being rendered more or less conspicuously granular by oblique, decussating transpiral grooves. The lowermost spiral rib in each whorl of the spire is more strongly raised than the rest, but at the periphery of the body whorl there are two such strongly marked spiral ribs, separated by a deep narrow groove ; the lower surface is not quite flattened, and the wide circular umbilicus in the centre bears a toothed margin as usual. Both the specimens are more or less uniformly pale brownish. Pamban.

Torinia fulva (Hinds).

Solarium fulvum, Hinds, Proc. Zool Soc London, 1844, p 23

A single dry specimen from Pamban is represented in the gallery collection. The shell is very small, circular in profile and disc-shaped, the spire being markedly depressed and the upper surface strongly flattened, being much less convex than in *T. dorsuosa*. The surface bears a fine latticed sculpture consisting of strong, close-set, transpiral ribs, decussated by weaker spiral ridges and rendered somewhat granular by being cut up by the interstitial grooves between the latter. The periphery of the body whorl bears a strong keel made up of two stout, particularly well raised spiral ribs separated by a deep, channel-like groove ; these strongly developed spiral ribs are rendered markedly beaded in appearance by the intersecting transpiral ribs which extend on to them. The basal surface is somewhat rounded and bears finely granulated ridges. The umbilicus is wide open, circular and bears a crenated margin. The aperture is slightly broader and more rounded than in *T. dorsuosa*. The shell is rather faded, and appears more or less uniformly pale bluish grey, but traces of the original yellowish brown tint are still seen, particularly near the sutures. Pamban.

Family VERMETIDAE.

The shell is generally attached and the whorls are more or less irregularly uncoiled ; sometimes the whorls are regular at first, but become irregular distally. The sculpture is variable. The aperture is small and rounded. The operculum is horny. The animal bears a short snout and small cephalic tentacles. The foot is without a creeping sole.

The extreme variability in form of the members of this family renders their specific identification a matter of great difficulty. Schepman rightly asserts that this is " the most disagreeable family of Gastropods to deal with ".

Two genera, *Vermetus* and *Tenagodus* (=*Siliquaria*), are represented at Pamban. The latter is easily distinguished from the former by the presence of a well defined longitudinal slit in the wall of the tubular shell, extending to a greater or less extent the entire length of the whorls, and which often presents a beaded appearance.

Genus **Vermetus** (Adanson, 1757) Daudin, 1800.

The shell is variously shaped and sculptured, without longitudinal slit on the wall. The operculum is moderately thick, circular, and usually concave outside. The animal bears a more or less deep pallial cleft. The ctenidium is moderately elongated.

This genus is represented by three species belonging to three different sub-genera, namely, *Vermetus s. str.*, *Spiroglyphus* and *Vermicularia*; these three sections of the genus may be distinguished as follows :—

1. Shell attached to or embedded in larger molluscan shells or pieces of stone ; spirals of the whorls irregularly unwound throughout the length of the shell ; aperture and operculum small	2
—Shell not attached or embedded ; whorls at the commencement regularly spirally twisted somewhat as in *Turritella*, but irregularly trailing or stretched out towards the wider end , aperture comparatively large and operculum as large as aperture	*Vermicularia.*
2. Shell almost wholly embedded in the substratum, irregularly disc-shaped or more elevated, often with oblique wrinkles on the surface ; operculum concentric	*Spiroglyphus.*
—Shell not completely embedded in the substratum, the terminal portions of the tubular shells freely projecting well beyond the surface of the substratum ; spirals of the shell tortuously twisted ; surface frequently puckered ; operculum small, simple ..	*Vermetus s. str.*

Sub-genus **Vermetus** s. str.

This section of the genus is represented by a single unidentified species.

Vermetus sp.

Plate V, figs. *2a* to *2c*.

Three pieces of dead coral stone, profusely invaded by numerous narrow, worm-like, tubular shells, and collected from Krusadai Island, are represented in the collection. The animals are gregarious and large numbers of them live attached by their shells to stone or other substrata, with their small, circular apertures exposed. The terminal portions (*i.e.*, part towards the aperture) of the tubular shells are free and protrude well beyond the surface level of the substratum as short, tubular ' outgrowths ' with the apertures at their ends. The

opercula are lost in most of these shells, but in one or two, they may be seen as small, externally concave, horny discs. The shells are bright brownish, with a somewhat uneven surface bearing depressions and elevations. Such masses of intertwined shells of *Vermetus* are found attached to dead coral stones on the reefs, and may be readily chiselled off. Krusadai Island.

Sub-genus **Spiroglyphus** Daudin, 1800.

Spiroglyphus spirulaeformis (de Serres).

Plate V, figs. 3*a* and 3*b*.

Stoa spirulaeformis, de Serres, Ann. Sci, IV, 1855, p. 241.
Spiroglyphus spirulaeformis Tryon, Man. Conch., VIII, 1892, pl. 57, fig 78.
Vermetus (*Spiroglyphus*) *andamanicus* Prashad and Rao, Rec. Ind Mus, XXXV, 1933, p 410.

A few specimens collected from Krusadai Island, and preserved in spirit, are represented in the collection. The shells are all completely embedded in pieces of coral rock, and their positions are indicated externally by small, circular apertures on the surface ; these apertures mark the distal ends of the tubular shells, and are closed up by horny, dark brown opercula which are more or less cup-shaped, being deeply concave outside ; the operculum is small, circular, and barely exceeds a millimetre in diameter ; it bears numerous concentric striae around a central nucleus. The shell is so intimately attached to the coral stone that it is almost impossible to remove it intact. It is dark brownish, transversely striated on the outer surface, and traces a tortuous course into the substance of the coral into which it has bored. The animal, when extracted from its shell, resembles somewhat a slender, coiled worm, with a muscular, cylindrical foot to which the operculum is attached The mantle is pale brownish. Krusadai Island.

Sub-genus **Vermicularia** Lamarck, 1799.

Vermicularia inopertus (Ruppell).

Vermetus inopertus, Ruppell & Leuckart, Atlas Wirbellose, 1830, p. 38.
Vermicularia inopertus, Tryon, Man Conch., VIII, 1892, pl. 54, fig. 78.

A single rather mutilated specimen, collected by Dr. Gravely from Krusadai Island, has been doubtfully referred to this species by Mr. Winckworth to whom it was sent for identification. Unlike the two preceding species, the shell is not attached to any substratum in *Vermicularia*. The shell is tubular, as is usual in Vermetids, but the bore of the tube is much wider than in the two foregoing species, being not less than 5 mm. in diameter. The shell which is partly encrusted with coral growth on the surface, is unfortunately broken (probably in the act of extracting the animal), and as the pieces in the collection evidently represent only portions of the shell, the exact shape and appearance of the entire shell cannot be ascertained from a study of this specimen. The shell is pure white, and its outer surface

is sculptured with stout, broadly rounded spiral ribs ; in addition to this, the surface is finely granulated all over ; the inner surface is smooth, white and slightly glossy. The animal, which has been pulled out of the shell, is dark greenish brown in spirit, and is stoutly vermiform, with a cylindrical foot bearing a flat, truncated, terminal surface to which the operculum is attached during life, but the latter has been lost in the present specimen. Since Mr. Winckworth is somewhat uncertain regarding the identification of this specimen, further specimens should be collected and examined before confirming this record. Krusadai Island.

Genus **Tenagodus** Guettard, 1774.

(Syn **Siliquaria** Bruguière, 1792.)

The shell is tubular, with the spirals irregularly unwound ; it bears a narrow, longitudinal spiral fissure along the wall of the whorls ; this slit is often articulated and consequently presents a beaded appearance. The operculum is thick, cylindrical or conical.

Two species, *T. lacteus* and *T. encausticus* are represented The latter is readily distinguished from the former by the outer surface of the shell being more strongly wrinkled and by the spiral fissure being closed in the upper whorls.

Tenagodus lacteus (Lamarck).

Siliquaria lactea, Lamarck, Anim sans vert., V, 1818, p 338.
Siliquaria lactea, Reeve, Conch Icon , XX, 1878, *Siliquaria*, pl 11, fig 5
Siliquaria lacteus, Tryon, Man. Conch , VIII, 1892, p 191, pl 58, fig 26
Tenagodus (Pyxipoma) lacteus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 185

This species is represented in the collection by a single dead shell, which is entire and preserved in good condition. The shell is moderately small and slender, its bore being somewhat narrower than in *T. encausticus*. Apically, the shell tapers down to a very narrow tube, and here the whorls are much closer together, and form a more or less compact, pyramidal group, but lower down they are very loosely and irregularly unwound. The surface is rather rough and finely concentrically striated, but the lower whorls bear a faint spiral ribbing in addition to the concentric striation, but the surface is never so strongly wrinkled as in the next species. The lateral spiral fissure extends almost throughout the extent of the tubular shell, being partially closed only very near the apex, and is articulated throughout, unlike the condition seen in the next species The shell is whitish all over, and its interior is slightly glossy. Shells of this species are gregarious and tend to form large conglomerated masses by closely intertwining with each other , hence the difficulty in isolating individual shells without breaking portions of them. Pamban.

Tenagodus encausticus (Morch).
Plate V, fig. 4.

Siliquaria encaustica, Morch, Proc Zool Soc. London, 1860, p. 408
Siliquaria encaustica, Reeve, Conch. Icon., XX, 1878, *Siliquaria*, pl iv, fig 10.

A single, rather bleached, empty shell, broken towards the lower end, and taken on the beach on Krusadai Island, is represented in our collection. It is whitish, tubular and coiled, with a characteristically beaded spiral fissure, and with the small upper whorls rather closely pressed together. The fissure is closed in the apical whorls, and towards the distal extremity tends to lose its beaded appearance and becomes simple and unarticulated The outer surface of the shell is crudely, but strongly concentrically wrinkled. The interior of the shell displays a fine, silvery gloss. The specimen agrees admirably well with Reeve's figure and description of *Siliquaria encaustica* Morch, but it should be remembered that this identification needs confirmation by examining further specimens from the locality. Considering the fact that this species has been recorded from Ceylon, it is not improbable that it should occur in the Pamban area. Krusadai Island.

Family MELANIIDAE.

The shell is moderately large, rounded, or more often tower-shaped, smooth or with varied sculpture, frequently ridged, and covered with a blackish brown periostracum. The aperture is ovate, and the operculum horny and spiral.

The Melaniidae are inhabitants of fresh water.

A single genus, *Melania*, represented by a single species, has been recorded from Pamban.

Genus **Melania** Lamarck.

(Syn. **Tiara** Bolten, 1798.)

The shell is ovately elongated, with a tall, moderately slender spire The whorls are ornamented with spiral ridges which are often tuberculated. The aperture is ovate, entire in front, and pointed behind.

Melania tuberculata (Muller)
Plate V, fig. 5.

Nerita tuberculata, Muller, Hist Verm., II, 191, 1774, Coromandel, H. & T., C I, pl 74, figs 1–4.
Tiara tuberculata, Nevill, Handlist of Mollusca in the Ind. Mus, pt ii, 1884, p 239.
Melania layardi, Dohrn, Proc Zool Soc London, 1858, p 135.
Melania tuberculata, Brot, Martini-Chemn Conch Cab, Ed II, Vol II, 1859, *Melania*, p. 321, pl. 33, fig 13.
Melania tuberculata, Reeve, Conch. Icon, XII, 1860, *Melania*, pl xiii, fig. 87
Melania layardi, Reeve, ibid., pl. xv, fig 104
Melania tuberculata, Fischer, Journ. de Conchyl., XXIV, 1876, p. 258.
Melania (Melanoides) tuberculata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 100.

A few shells collected from pits for fresh water among the coconut palms in the interior of Krusadai Island are represented in the collection. The shell is thin, rather small, with

a moderate-sized body whorl and tall, somewhat slender, turretted spire. The surface is sculptured throughout with fine, well separated spiral ridges which are regularly, but rather bluntly tuberculated, the position of these tubercles coinciding with those of the transpiral plaits into which the surface is thrown, and which are especially well marked in the lower whorls of the spire. The columella is very thinly callous, its surface being smooth and bearing a slight pearly gloss. The aperture is oblong-ovate and entire, both behind and in front.

The Krusadai specimens are all rather small, hardly exceeding a length of about 1½ cm. They belong to the variety *layardi* Dohrn, being of an olive brown colour, ornamented with regular, reddish brown transpiral lines ; the regions immediately below the sutures are somewhat darker brown than the remaining parts, while the base of the body whorl is of a very dark, deep purplish brown tint. This variety has been recorded from Ceylon and South Canara. Krusadai Island.

Family PLANAXIDAE.

The shell is without an umbilicus, often with a thick periostracum, usually ovately conical, smooth or with spiral sculpture ; the columellar border is callous, the callus deposit being thick above, but flattened below ; there is usually a distinct, thick, spiral ridge running inwards from the inner side of the posterior canal.

A single species belonging to the ganus *Planaxis* is recorded.

Genus **Planaxis** Lamarck, 1822.

Shell with the characters of the family.

Planaxis sulcatus (Born).

Plate V, figs. 6*a* and 6*b*.

Buccinum sulcatum, Born, Index, Mus Caes. Vindobon, 1778, p 251, pl. 10, figs. 5 and 6.
Planaxis sulcatus, Reeve, Conch Icon , XX, 1878, *Planaxis*, pl 1, fig 4
Planaxis sulcata, Watson, " Challenger ", Zoology, XV, 1886, Gastropoda, p 573.
Planaxis sulcatus, Tryon, Man Conch , IX, 1894, p 276, pl 52, figs 22 and 23
Planaxis sulcatus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr, XLIX, 1908, p 171.
Planaxis sulcatus, Crichton, Journ Bomb Nat Hist Soc , XLII, 1941, p 337.
Planaxis sulcatus, Gravely, Bull Mad. Govt Mus (Nat Hist), V, No 2, 1942, p 24.

This is a moderately common and widely distributed species, with a somewhat small, thick, solid, dark-coloured shell, specimens of which are often found living abundantly in certain areas on the reefs in company with those of some of the commoner species of *Cerithium* and *Nerita*. In shape and appearance it is not much unlike that of a small *Littorina*, but the shell is much thicker and stronger, with the spire slightly less strongly raised, and the apex less sharply pointed. In most specimens the spire is often more or less corroded. The body whorl is slightly angular below. The surface of the shell is regularly and uniformly spirally grooved. The aperture is narrowly ovate and its outer lip is distinctly spirally ridged

within, these ridges corresponding with the positions of the external grooves. The callus on the columella is thick above, but thin and lamina-like below, where it borders the short, but deeply excavate, V-shaped anterior canal. The stout, white, spiral ridge running inwards from the posterior end of the columellar border is very distinct, and immediately below this ridge one or two of the spiral grooves of the body whorl may sometimes be continued across the columella into the interior of the aperture. The posterior canal is represented by a shallow groove. The operculum is horny, thick, with an almost terminal nucleus. The shell is blackish, or blackish-green or brown, with whitish markings which are generally disposed in the form of irregular transpiral bands. Large numbers of both dead shells and living specimens have been collected. Pamban, Pulli reefs, Krusadai and Shingle Islands.

Family POTAMIDIDAE.

The shell is tall, elongately cone-shaped, with numerous whorls ; it is usually strongly sculptured, either tuberculated or spirally ridged ; the whorls are scarcely inflated, being more or less straight-sided. The aperture is generally provided with a distinct anterior canal. The operculum is horny and centrally nucleated. Members of this family are popularly known as telescope shells.

Two genera, *Cerithidia* (= *Potamides*) and *Terebralia*, each represented by a single species, have been recorded from Krusadai. The latter can be readily distinguished by the shell being almost always very large and thick, and by the spiral ridges on the surface being devoid of distinctly developed, well separated tubercles.

Genus **Cerithidea** Swainson, 1840.

The shell is moderately small, tower-shaped, with numerous, scarcely inflated whorls. The spiral ridges on the surface are usually strongly tuberculated.

Cerithidea fluviatilis (Potiéz and Michaud).

Plate V, figs. *7a* and *7b*

Potamides fluviatilis, Potiéz and Michaud, Cat Moll Douai, II, 1838, p. 363, pl. 31, figs. 19 and 20
Cerithium fluviatile, Kiener, Coq. Viv., V, 1841, *Cerithium*, p 92, pl. 29, fig. 3.
Tympanotonos fluviatilis, Reeve, Conch Icon., XV, 1864, *Tympanotonos*, pl 11, fig 9.
Potamides (Tympanotonos) fluviatilis, Schepman, Siboga-Expeditie, Monogr XLIX, 1908, p. 168.
Potamides cingulatus, Hornell, Common Molluscs of South India, Mad Fish Bull, XIV, 1921, p. 110.
Cerithidea cingulata, Crichton, Journ Bomb Nat Hist Soc, XLII, 1941, p 339.
Cerithidea fluviatilis, Gravely, Bull Mad Govt Mus (Nat. Hist), V, No. 2, 1942, pp. 24 and 25.

This is perhaps the most abundantly occurring Gastropod in the Pamban area, being found in very large numbers in certain localities, particularly on the mud flats at Kundugal Point, where vast areas are literally strewn with enormous numbers of shells of this species, many of which, however, are occupied by hermit crabs ; as this species is an inhabitant of backwaters, it is not represented on the reefs exposed to the open sea.

The shell is small, somewhat narrow and moderately elongate ; the surface of each whorl bears four distinct spiral ridges, the lowermost of which is very thin, whitish and thread-like, while the remaining three above are broader and strongly tuberculated, the uppermost being the widest and of a lighter colour than the two median ridges. The tubercles on the ridges are so arranged as to form regular transpiral rows ; in the body whorl, however, only the uppermost ridge is tuberculated ; the grooves separating the ridges on the body whorl diverge fan-wise towards the edge, the outer lip being somewhat broadly expanded. The anterior canal is represented by a deep notch. There is a slight, but distinct, transpiral, ridge-like elevation on the surface of the body whorl immediately above the inner border of the aperture. The shell is of a dark greyish colour, and measures about 0·9 inch in height on the average. Kundugal Point, Pamban and Krusadai Island.

Genus **Terebralia** Swainson, 1840.

The shell is thick, usually large, elongately cone-shaped, with scarcely inflated whorls, bearing spiral grooves and more or less stout transpiral ribs. The outer lip of the aperture is broadly expanded and the anterior canal is represented by a deeply excavated, short, spout-like projection.

Terebralia palustris (Linné)

Plate VI, fig. 1

Potamides palustris, Linné, Syst. Nat, Ed XII, 1791, p. 1213.
Cerithium palustre, Kiener, Coq Viv, V, 1841, *Cerithium*, p 81.
Pyrazus palustris, Reeve, Conch Icon, XV, 1864, *Pyrazus*, pl. 1 fig. 2
Potamides (Terebralia) palustris, Schepman, Siboga-Expeditie, Monogr. XLIX, 1908, p. 168.
Potamides palustris, Hornell, Common Molluscs of South India, Mad Fish Bull, XIV, 1921, p. 110.
Terebralia palustris, Gravely, Bull. Mad Govt Mus (Nat Hist), V, No 2, 1942, p. 25.

Unlike the preceding species, specimens of *T. palustris* are never plentiful, but still several large shells, mostly empty or occupied by hermit crabs, have been collected especially at Kundugal Point. The shell is thick, rather coarse-looking, with an elongated spire and numerous straight-sided whorls, and is much larger and stouter than that of the preceding species, some specimens reaching a length of nearly four inches. The surface of the whorls bears deeply incised, regularly spaced spiral grooves, separated by broad, flattened inter-spaces ; apart from this, the surface also bears stout, straight-edged, flattened transpiral ribs, which are more conspicuous and widely separated in young shells. The sutures are well sunk in grooves which are wider and much deeper than the sculptural grooves. The sutural grooves are rendered slightly undulating in appearance by the presence of the transpiral ribs which abut on them. While collecting, shells of this species are rarely found in a complete state, for the outer lip is usually found broken, often far back, and consequently the fold on the columella and the prominent internal teeth of the outer lip are exposed ; in such specimens

the interior of the shell opposite the columella, therefore, reveals three teeth, the uppermost of which is the largest and well separated from the other two, which are smaller and close to each other, and the lowermost the smallest ; in such broken specimens, the width of the aperture is much reduced, and the anterior canal much shallower. In a perfect specimen, however, the outer lip is seen as a broadly expanded, convex structure protruding well beyond the general level of the body whorl. The shell is dark purplish brown, but sometimes the colour fades into a pale brown. Krusadai Island and Kundugal Point.

Family CERITHIIDAE.

The shell is moderately small with an elongated spire ; the whorls are scarcely, or only slightly inflated and ornamented with strong, often tuberculated sculpture. An anterior canal is present, but short and sometimes reduced. The operculum is horny and excentrically nucleated. This family includes the horn shells.

Two genera, *Colina* and *Cerithium* are represented at Pamban. The former, including only a single Pamban species, is readily distinguished from the latter which comprises the remaining species, by the shell being thin and more or less slender, the outer lip being rather broadly expanded and the body whorl being much contracted.

Genus **Colina** H & A. Adams, 1854.

The shell is moderately small, usually thin-walled and glossy, as a rule slender and turretted, with sharp apex and numerous whorls which increase only very slightly in size from above downwards ; the shell is sculptured with close-set striae and ribs. The outer lip is rather expanded.

A single species has been recorded from Pamban.

Colina pupaeformis A. Adams.

Colina pupiformis, A. Adams, Proc Zool Soc. London, 1853, p 176
Cerithium pupiformis, A. Adams, Sowerby's Thes Conchyl , II, 1855, *Cerithium*, No 127, fig. 221
Cerithium pupaeforme, Reeve, Conch Icon., XV., 1866, *Cerithium*, pl. xvii, fig. 122

This species is uncommon at Pamban, and is represented in the gallery collection by two dead shells. The shell is smallish, thin-walled, slender and considerably elongate, with a rather unusually narrow body whorl somewhat markedly contracted towards the base, and an elevated spire with numerous whorls. The surface is strongly spirally grooved throughout, and also bears stout, broadly rounded transpiral ribs, but the latter are rather feebly developed on the body whorl In each whorl, immediately below the suture, there is a well defined, though slightly raised, spiral riblet, the surface of which is very finely and closely transpirally grooved. The whorls are slightly angular about the middle, and those at the middle of the shell are faintly inflated. The aperture is ovate, with a thin, slightly expanded outer lip which is feebly angular below and an arched columellar border which is obliquely striated.

The anterior canal is well defined, deeply excavated, and very slightly produced. The apex of the shell is fragile and is wanting in both the shells, this being the condition also in the shells figured by Reeve. The shell is uniformly whitish. Pamban.

Genus **Cerithium** Bruguière, 1789.

The shell is moderately thick, tower-shaped and generally strongly and variously sculptured. The aperture is narrowly ovate , the columellar margin bears a deposit of callus.

Ten species are known from Pamban ; they may be distinguished with the aid of the following key :—

1\. Shell somewhat slender and considerably elongated ; spire with numerous whorls 2

— Shell definitely not slender, not greatly elongate in proportion to width, broader, rather swollen below, and spire with relatively less numerous whorls ... 6

2\. Whorls with distinct spiral rows of tubercles ; transpiral plaits on the surface inconspicuous or absent 3

— Whorls spirally ridged, and also with more or less strong, transpiral folds or crests in addition to the spiral ridges 4

3\. Shell very slender, dark brownish, whorls at most with two rows of stout tubercles, those of the lower row being larger ; aperture broadly rounded ; anterior canal not well defined ... ... *C. tenellum.*

— Shell not as above ; less markedly slender ; aperture narrower, ovate ; anterior canal well defined ; tubercles relatively smaller and less pronounced .. *C. trailli.*

4\. Shell very tall, usually large, with numerous, strong, convexly arched transpiral crests on the surface of all the whorls ; spiral ridges alternately strong and weak . ... *C. citrinum.*

—Shell smaller, not so narrow, relatively less elongated ; transpiral crests such as those of the above absent ; spiral ridges, when present, not alternately strong and weak 5

5. Whorls with three spiral rows of tubercles ; tubercles not rounded, but flattened and compressed, sometimes tending to coalesce edge to edge and thus forming spiral ridges ; anterior canal deeply excavated and bounded by well defined sides ; aperture longer than broad ... . *C. scabridum.*

— Whorls distinctly spirally ridged and with raised transpiral ribs ; tubercles absent, or if present, very inconspicuous ; anterior canal only slightly excavted, its boundaries being less well defined ; aperture about as long as broad ... ... *C. proditum.*

6. Shell fairly large, with an elongated, ovately conical contour ; uppermost spiral row of tubercles in each whorl much more pronounced and stouter than those of the lower ones, and also sharply pointed ... ... *C. obeliscus.*

—Shell not as above, generally smaller 7

7. Shell very thick, rather rough-looking ; whorls strongly shouldered, shoulders rendering the whorls markedly angular about the middle and more strongly tuberculated than the rest of the surface ... ... *C. columna.*

—Shell not as above ; whorls not generally shouldered 8

8. Shell moderately large, thick, tubercles well separated, and more or less uniformly developed, shiny black in unworn shells ; posterior end of aperture constricted by a stout ridge running inwards from the upper end of the columellar border and forming a distinct, channel-like groove leading out by a small excavation ... ... *C. morus.*

— Shell smaller in average size, not so thick, tubercles whitish and not polished ; posterior canal absent or ill defined ; notch between outer lip and body whorl at the posterior end of aperture absent ... 9

9. Sides of shell rather rounded ; inner border of aperture with thin callus ; aperture slightly constricted posteriorly but not leading out by a notch ; anterior canal short and not conspicuously produced ... ... *C. clypeomorus.*

—Sides of shell straighter ; shell smaller, whitish ; callus absent ; aperture not constricted posteriorly ; anterior canal distinctly produced as a short, spout-like projection ... ... *C. splendens.*

Cerithium morus Lamarck.

Plate VI, fig. 2.

Cerithium morus, Lamarck, Anim. sans vert , (Deshayes' edit), II, Vol. IX., 1843, p. 302.
Cerithium morus, Kiener, Coq Viv , V, 1841, *Cerithium*, p. 52, pl. xv, fig. 1.
Cerithium morus, Reeve, Conch. Icon., XV, 1865, *Cerithium*, pl. vii, fig 42
Cerithium morus, Watson, " Challenger," Zoology, XV, 1886, Gastropoda, p 531
Cerithium morum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 160.

This is one of the commonest species of *Cerithium* met with at Pamban. The shell is rather short, ovate and presents a slightly inflated appearance. Each whorl of the spire is traversed by three distinct spiral rows of black, rounded tubercles, which are almost always glossy in fresh specimens. The body whorl, on the other hand, bears at least six or seven spiral rows of tubercles, and sometimes also finer secondary ones in between the principal rows. The interstices between the rows of tubercles are traversed by fine, thread-like spiral striae. The aperture is short, moderately broad, and more or less D-shaped. The posterior end of the aperture is constricted to form a groove, bounded internally by a stout ridge running inwards, somewhat as in *Planaxis sulcatus*. The outer lip is thick, and finely ridged at the margin on the inner surface. The anterior canal is short, but deeply excavated. The callus on the columella is distinct. The operculum is a flat, oval, horny plate with a very excentric nucleus. Large numbers of specimens are found alive, or occupied by hermit crabs, on the reefs. The shell is dark greenish grey. Pamban and Krusadai Island.

Cerithium obeliscus Bruguière

Plate VI, fig 3

Cerithium obeliscus, Bruguière, Encyclopédie Méthodique, Vers, 1792, p 472.
Cerithium obeliscus, Sowerby, Thes. Conchyl , II, 1855, p 851, pl. 177, figs. 30–32
Vertagus obeliscus, Reeve, Conch Icon , XV, 1866, *Vertagus*, pl ii, figs 7*a* and *b*.
Cerithium (*Aluco*) *obeliscus*, von Martens, Moll. Maskarenen, 1880, p 280 (104).
Cerithium obeliscus, Hornell, Common Molluscs of South India, Mad Fish Bull., XIV. 1921, p. 110.
Vertagus obeliscus, Dautzenberg, Faune Col Franç., 1929, III, p. 486 (Madag , p. 280)
Vertagus sinensis, Lamy, Journ. de Conchyl , LXXVII, 1933, p 318.

The shell attains a somewhat large size ; it is stout, with slightly arched sides, and presents a rather turretted appearance. The surface of the shell is strongly sculptured with regular spiral rows of tubercles, the uppermost of these spirals being the strongest and consisting of very strong, stout, raised and more or less pointed tubercles. The interstices between the spiral rows are traversed by a fine lattice consisting of closely inter-crossing spiral and

transpiral striae. The columella is covered by a fairly thick and extensive callus deposit. The anterior canal is deeply excavated and is produced into a conspicuous upwardly curved spout. The shell is generally pale brownish, variegated with whitish markings. This species is moderately common at Krusadai, and both live specimens and empty shells have been collected, mostly from the crevices of dead coral on the reefs. Pamban, Krusadai Island.

Cerithium citrinum Sowerby.

Plate IV, fig. 4.

Cerithium citrinum, Sowerby, Thes. Conchyl., II, 1855, p 179, fig. 66.
Cerithium echinatum, Kiener, Coq. Viv., V, 1841, *Cerithium*, p. 7, pl 11, fig. 1.
Cerithium citrinum, Reeve, Conch. Icon , XV, 1866, *Cerithium*, pl. 1, fig 1.
Cerithium citrinum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 157

This species is considerably rarer than the preceding one, and is represented only by a few dead shells in the collection. The shell attains a moderately large size, and has a more slender and elongate spire than in *C. obeliscus*. The whorls are beset with strongly developed, somewhat widely separated transpiral crests, and on the body whorl a more or less pronounced varix is developed on the side opposite to the aperture. In addition to the transpiral crests the surface bears well developed spiral ridges, and finer, thread-like secondary striae between the main ridges ; this spiral sculpture is specially well marked in the interstices between the transpiral crests. The aperture is ovate, the callus on the columella thin and the anterior canal short and straight. The whorls are slightly angularly inflated about the middle. The shell is dull brownish or greyish when fresh. Pamban and Krusadai Island.

Cerithium scabridum Philippi.

Plate VI, fig. 5.

Cerithium scabridum, Philippi, z Malak , V, 1848, p 23
Cerithium scabridum, Reeve, Conch. Icon , XV, 1866, *Cerithium*, pl viii, fig 52

Specimens of this species are moderately abundant at Krusadai, and numerous dead shells have been picked up on the beach at Krusadai and Pulli Islands. The shell is much smaller in average size than that of any of the preceding species and the spire is somewhat more slender than in *C. morus*, though not as much elongated as in *C. citrinum*. The whorls are rather angular about the middle, but this feature is not conspicuous in some specimens, especially in young shells. The angular portions of the whorls are generally more strongly tuberculated than the parts above and below them. The tubercles are neither quite rounded nor distinctly separated from one another, but often laterally elongated and tend to coalesce with one another forming spiral ridges. The interstices between the tuberculated spirals are traversed by fine spiral striae. The base of the shell is somewhat abruptly narrowed, the aperture being narrowly ovate and the anterior canal slightly produced. The shell is generally pale greyish brown, but may be occasionally darker. Krusadai Island and Pulli reef.

Cerithium proditum Bayle.

Cerithium fusiforme, Sowerby, Thes Conchyl, II, 1855, p 862, pl 180, figs 106 and 107
Cerithium proditum, Bayle, Journ de Conchyl, XXVIII, 1880, p 246 (not 249), new name for *C. fusiforme* Sowerby, 1855, non Leymerie, 1844
Cerithium proditum, Dautzenberg & Bouge, Journ de Conchyl, LXXVII, 1933, p 310

Only a single specimen of this species, collected from Watchman's Bay at Krusadai, is represented in the collection. In this species the whorls of the shell are strongly plaited longitudinally somewhat as in *C. citrinum*, but the spire is considerably shorter and less slender than in the latter The strong, ridge-like transpiral plaits are markedly bulged out in the middle and regularly spaced ; in addition to these, there is a well marked spiral sculpture consisting of strong spiral ridges and fine intermediate striae between the principal ridges. The aperture is rounded and the outer lip somewhat expanded. The anterior canal is short and only slightly excavated and there is practically no trace of callus on the columella. The single shell present in the collection is rather bleached and almost whitish. Krusadai Island.

Cerithium clypeomorus (Jousseaume).

Clypeomorus clypeomorus, Jousseaume, Mem. Soc., Zool Fra, I, 1888, p. 171.
Cerithium clypeomorus, Fischer, Journ. de Conchyl, XLIX, 1891, p. 112

This species is tolerably common at Pamban, and numerous shells have been collected from the sand at Watchman's Bay on Krusadai Island. In shape and general appearance the shell resembles very much that of *C. morus*, but the spire is slightly more elongated in proportion to the width of the body whorl, and the shell is much smaller in average size There are three conspicuous spiral rows of tubercles on each whorl, the tubercles tending to be transversely elongated ; the interstices between these tuberculated spirals are traversed by fine, smooth, thread-like spiral ridges. The aperture is ovate, and bears at its posterior end a prominent ridge running spirally into the interior at the inner border. The anterior canal is short and not appreciably produced ; there is a thin, polished callosity on the columellar border of the aperture. Most of the specimens in the collection are of a dull greenish brown colour. Krusadai Island.

Cerithium splendens Sowerby.

Plate VI, fig 6.

Cerithium splendens, Sowerby, Thes Conchyl., II, 1855, *Cerithium*, sp. 101.
Cerithium splendens, Reeve, Conch. Icon, XV, 1866, *Cerithium*, pl. iii, fig 19

The shell in this species is smaller than those of any other recorded from Pamban. It is moderately short and pyramidal, with the base rather abruptly narrowed, and the anterior canal sharply produced as a short, spout-like projection. The whorls are encircled with

strong nodular spiral ridges, the interstices between which are traversed by fine spiral striae. The aperture is ovate and not constricted posteriorly, and the columellar border is almost totally devoid of callus. The shell is usually whitish or pale brownish, but in fresh specimens the tubercles on the spiral ridges are alternately white and dark brown. Krusadai Island, Pamban.

Cerithium columna Sowerby.

Cerithium columna, Sowerby, Genera of Shells, II, 1821, No. 42, fig. 7
Cerithium columna, Reeve, Conch. Icon, XV, 1866, *Cerithium*, pl 1, fig. 2.
Cerithium columna, Dunker, Index Moll, Mar Japon, 1882, p. 106.
Cerithium columna, Watson, "Challenger", Zoology, XV, 1886, Gastropoda, p. 531.
Cerithium columna, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 157

This species can be readily distinguished from the rest by the extremely coarse and roughened appearance of the surface of the shell. The spire is moderately high, but not very slender, and the body whorl fairly wide, its maximum width being well over three quarters of the height of the spire. The surface of the whorls is traversed by widely spaced, strong, sharply raised, crest-like transpiral ridges, which are more or less sharply pointed and angular about the middle so as to give the whorls a markedly angular contour ; in addition to these longitudinal plaits there are numerous finer irregular spiral ridges ; the apex of the spire is not sharply pointed. The aperture is large, more or less rounded and bears an anterior as well as a posterior canal, the latter being the shorter and sharply constricted. This species is represented by two shells in Mr. Chichton's collection. The specimens differ somewhat from one another, but considering the range of variation said to be presented by this species it is not unlikely that both of them belong to the same species, especially as one of them approaches fig. *a* and the other fig. *b* of Reeve's illustration of this species. The former is taller, whitish, with brown lines and streaks between the plaits while the latter is shorter and broader, blackish brown, variegated with white, and with the plaits irregular and indistinct ; it is not quite certain whether the latter should be referred to this species. Pamban.

Cerithium trailli Sowerby.

Cerithium trailli, Sowerby, Thes Conchyl, II, 1855, *Cerithium*, sp 93
Cerithium trailli, Reeve, Conch Icon., XV, 1865, *Cerithium*, pl. iv, fig. 24.

This species is represented in Mr. Crichton's collection by a few dead shells from Pamban. The shell is tall and somewhat slender with a sharply pointed apex and a finer and more regular sculpture than in most other species of *Cerithium* recorded in this account. The whorls are almost perfectly straight-sided, not angularly raised at the middle. Regular transpiral crests (such as in the preceding species) are wanting, but there are whitish varices here and there, irregularly disposed on different radii on the different whorls. The whorls are traversed uniformly by regular, spiral rows of small, rounded tubercles, the interstices between

these rows being finely spirally striated. The aperture is ovate and constricted posteriorly ; the anterior canal is short and oblique. The outer lip is expanded, its edge thickened and its inner margin finely crenulated. There is a thin callus layer on the columellar margin. The shell is pale brownish, but the tubercles are much darker brown than the ground colour. Pamban.

Cerithium tenellum Sowerby.

Cerithium tenellum, Sowerby, Thes. Conchyl., II, 1855, *Cerithium*, sp. 31
Cerithium tenellum, Reeve, Conch Icon , XV, 1865, *Cerithium*, pl. xi, fig. 71
Cerithium tenellum, Tryon, Man Conch , IX, 1894, p 132, pl 23, figs. 10 and 11
Cerithium tenellum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 160.

This species is relatively rare in the Pamban area, and is represented by a single specimen in Mr. Crichton's collection. It is a moderately small, somewhat thin and slender shell with a tall attenuated spire and glossy surface. There are two spiral rows of whitish, strongly developed tubercles on each whorl ; the tubercles are rounded and somewhat polished. The interstices between the tubercles are finely transpirally striated. The sutures are deeply immersed and are immediately followed by a thin, thread-like ridge above. The aperture is small and rounded, and the anterior canal is not produced. The shell is brownish, but the tubercles are white. Pamban.

Family TRIPHORIDAE.

This family is closely allied to the preceding one. The shell is almost always sinistral, very small and turretted. The whorls of the embryonic shell are united and sculptured with one or two spiral ribs and finer transpiral ribs, while the succeeding whorls bear tuberculated, seldom smooth, spiral ridges. The aperture is small, the columella bears a thin callus deposit and the anterior canal is short and more or less curved. The operculum bears an almost central nucleus. The foot is slender and elongated. The tentacles are filamentous.

This family included a single genus, *Triphora*.

Genus **Triphora** Blainville, 1828.

The characters are the same as those of the family.

This genus is represented at Krusadai by two species, *T. concinna* and *T. violacea*. In the latter, the shell is larger, beautifully violet or pinkish violet throughout, and has the granules on the surface more strongly developed, while in the former the shell is minute, whitish, with brownish spiral bands at the sutures and much finer granules on the surface.

Triphora concinna Hinds.

Plate VI, fig. 7.

Triphoris concinnus, Hinds, Ann. & Mag. Nat. Hist., XI, 1843, p. 20.

This species is considerably rarer at Pamban than the next, only four dead shells being contained in the museum collection. The shell is very small, scarcely exceeding a length of 4 mm., ovately elongate, with a small body whorl and a narrow and elongately conical spire bearing about 8—9 whorls. The surface of each whorl is elegantly sculptured with three finely granular spiral ridges, but on the body whorl, the lowermost row, instead of being single as in the whorls of the spire, is duplicated twice so that there are on the whole five granular spiral ribs on the body whorl, the two lowermost ones being much finer. The aperture is small, ovate, with a short, slightly flexed, deep, almost tubular anterior canal. The outer lip is thin and is broken in three out of the four shells in the collection. The shell is whitish or very pale brownish, prettily marked with a dark brownish spiral band at the lowermost portion of each whorl (i.e., in the rigion of the third granular spiral ridge) ; this band is broader at the base of the body whorl where it extends over the outer surface of the canal. Pamban.

Triphora violacea (Quoy and Gaimard).

Plate VI, fig. 8.

Cerithium violoceum, Quoy and Gaimard, Zoology of the Voyage de L'Astrolabe, II, 1834, p 134

Though this species had been treated by its authors as a member of the genus *Cerithium* they admit that it properly belongs to the division of *Triphora*, comprising the sinistral shells. Specimens of this species are decidedly much commoner than those of the preceding species, a good number of live shells having been collected from the surface layers of sand on the shore line at Sandy Point on Krusadai Island ; I have seen a number of them while digging for Polychaet worms in this locality. The shell is small, but still considerably larger than in *T. concinna*, and comparatively stouter, with an elongate, acuminated spire. The surface of the shell is strongly and regularly sculptured, each whorl bearing about two spiral rows of stout, rounded tubercles, but on the body whorl, there are three (or sometimes four) spiral rows of much finer granules beneath the two principal ones. The interstices between the spiral rows of tubercles sometimes bear a fine (often feebly granulated) spiral ridge. The large rounded tubercles bear a slight gloss in fresh shells. The aperture is small, almost rounded, with its margin appearing practically entire, but it bears on its right side a little towards the base, a short, obliquely projecting and slightly curved, almost closed and tubular anterior canal. The outer lip is thin, and is found broken in almost all dead shells washed up on the beach, but intact in fresh shells collected alive. The shell is of a beautiful pinkish

violet colour, which is much brighter in live specimens ; the granules are almost always whitish. Krusadai Island and Pamban.[1]

SERIES PTENOGLOSSA.

Family JANTHINIDAE.

The shell is thin and fragile, with a moderately low spire and inflated body whorl, either smooth or faintly striated. The aperture is ovate, with an angular columellar border. The umbilicus and operculum are absent. The foot is moderately broad, and secretes a frothy float to which the eggs are attached. This family includes the violet snails, which are eminently adapted to a pelagic existence.

A single genus, *Janthina,* occurs at Pamban, and is represented by two species, *J. roseola* and *J. globosa,* both of which are also known from the Madras area.

Genus **Janthina** (Bolten) Röding, 1798.

The shell is violet, often darker below ; the spire is usually moderately low with few whorls, either smooth or feebly striated. The aperture is wide with an angular columellar border. The outer lip is generally more or less distinctly sinuate.

In *J. roseola,* which is much commoner than *J. globosa* at Krusadai, the body whorl is markedly angular and the lower part of the shell somewhat flattened, while in the latter the body whorl is more rounded and almost globular.

Shells of both species, especially the former, may be frequently seen washed up on the beach with the whitish froth-like float still attached.

Janthina roseola Reeve.

Plate VI, fig. 9.

Ianthina roseola, Reeve, Conch. Icon , XI, 1858, *Ianthina,* pl 1, fig. 1.
Janthina roseola, Sowerby, Thes. Conchyl , V, 1882, p 50, pl. 443, fig 1.
See also von Martens, Tief. Exp , VII, 1903, p. 142
Ianthina roseola, Crichton, Journ. Bomb Nat Hist Soc , XLII, 1941, p 329
Janthina roseola, Gravely, Bull Mad. Govt Mus (Nat Hist.), V, No 2, 1942, p. 28.

Mr. Winckworth reports that there is much uncertainty as to the number and limits of the species of *Janthina* ; some consider this Indian Ocean form identical with the Atlantic form *Helix janthina* Linné, 1758 (*Janthina fragilis* Lamarck, 1816) ; he observes that this is quite possible in view of the fact that *Janthina* is a pelagic genus.

[1] It is probable that *T. cingulatus,* a species with a fine, very slender, greatly attenuated and elongate shell with numerous whorls, which has been recorded from Tuticorin, should also be found to occur at Pamban after further collection.

The shell is moderate-sized, with a more or less flattened basal surface and a markedly angular body whorl. The spire is somewhat low, with considérably depressed whorls. The suture is well marked, but not appreciably sunk below the general surface. The surface of the shell is minutely reticulately striated throughout, but this striation tends to be more strongly marked on the flattened lower surface of the shell. The aperture is large, somewhat squarish, the lower edge of its columellar margin being rendered strongly angular by the flattening of the lower surface. The portion of the surface above the angular part of the body whorl is pale violet, while the lower flattened part below the angle turns abruptly into a beautiful deep violet colour. Numerous shells especially those which have been freshly washed up on the beach and still have the soft parts and float intact, have been collected on Krusadai Island ; they are also particularly common on the Danushkodi coast where they are sometimes washed up in large numbers. Krusadai and Pulli Islands.

Janthina globosa Swainson.

Plate VI, fig 10.

Ianthina globosa, Swainson, Zoological Illustrations, first series, 1822, pl. 85.
Ianthina globosa, Reeve, Conch Icon., XI, 1858, *Ianthina*, pl iv, figs 18*a* and *b*.
Janthina globosa, Gravely, Bull. Mad. Govt Mus (Nat Hist), V, No. 2, 1942, p. 28

The shell is slightly larger in average size than that of the preceding species and may be readily distinguished from it by its large inflated, evenly rounded, almost globular body whorl which is not angular and flattened below as in *J. roseola*. The spire is short, but its whorls are slightly inflated. The suture is markedly depressed and appears as if it is sunk in a gróove. The surface of the whorls is finely transpirally striated ; on the body whorl these striae sharply change their direction at about the point where the angulation occurs in *J. roseola* ; in the lowermost part of the body whorl there are faint spiral grooves crossing the transpiral striae. The shells are as a rule violet throughout, but the region immediately below the sutures is very pale, sometimes almost whitish, while lower down the colour deepens and gradually shades off into the dark violet of the basal portion of the shell. The shells are very fragile and almost all specimens washed up on the beach have the edge of their outer lip broken ; many shells bear small clusters of the goose barnacle (*Lepas*) on their outer surface. Krusadai Island and Pamban.

SERIES AMALTHEACEA.

Family VANIKORIDAE.

The shell is umbilicated, with a small smooth embryonic shell and a large, inflated, rounded body whorl. It is colourless and sculptured with spiral ridges and more or less equally strong, obliquely transpiral ribs. The aperture is very large and inclining, its columellar margin being feebly arched and its outer lip strongly vaulted. The operculum is thin, with terminal nucleus. The snout is short and the tentacles stout.

This family includes a single genus, *Vanikoro*, which is represented at Pamban by a single species.

Genus **Vanikoro** Quoy and Gaimard, 1832.

[Syns **Narica** (Récluz) Orbigny, 1842 ; **Merria** Gray, 1839].

The characters are the same as those of the family.

Vanikoro granulosa (*Récluz*).

Plate VI, figs *11a* to *11c*.

Narica granulosa, Récluz, Proc. Zool. Soc London, 1843, p 140.
Vanikoro granulosa, Reeve, Conch. Icon, XX, 1878, *Vanikoro*, pl. II, fig 16

This species is rare and represented in the collection by only a single dead shell from Pamban. The shell is rather small, about 8 mm. in height and a centimetre in width. The spire is very small and depressed to a great extent, its apex being only very slightly exserted above the level of the body whorl. The body whorl is comparatively large, more or less depressly globular, and considerably widened towards the outer margin of the aperture. The surface bears a strongly developed sculpture consisting of stout, raised, spiral ribs which are regularly raised into strong, rounded nodules arranged in transpiral rows ; the interstices between these spiral ribs are traversed by very fine, close-set spiral striae. The entire surface is thrown into more or less strong, obliquely transpiral rib-like folds which coincide with the positions of the nodular swellings on the spiral ridges ; this arrangement gives the sculpture a regularly reticulated appearance. The aperture is very wide and more or less semicircular, the columellar margin being very slightly arched ; its border is unbroken by canals. The umbilicus is well marked. The shell is uniformly white throughout. Pamban.

Family AMALTHEIDAE.

The shell is cap-shaped or bowl-shaped, smooth or sculptured ; the embryonic shell is spiral ; an operculum is absent. The animal has a thick muscular snout bearing a pair of lobes terminally. The tentacles are awl-shaped, with small eyes near their tips. The foot is disc-shaped, thin marginally, but thick towards the middle.

A single genus, *Cheilea*, is represented at Pamban.

Genus **Cheilea** Modeer, 1793.

The shell is bowl-shaped, with the apex situated somewhat behind the middle ; the embryonic shell is spiral. The outer surface is variously sculptured, usually rough and uneven. The apex is provided internally with a folded appendage.

Two species of *Cheilea*, namely *C. equestris* and *C. undulata*, are recorded from Pamban. The former may be readily distinguished from the latter by the shell being much thicker, the surface being strongly and crudely spirally wrinkled, and by the apex being more sharply curved and situated much further back, almost directly above the hind border of the base of the shell.

Cheilea equestris (Linné).

Plate VI, fig. 12.

Patella equestris (pars) Linné, Syst. Nat., Ed. X, 1758, p 780
Calyptraea equestris, Reeve, Conch. Icon , XI, 1858, *Calyptraea*, pl 1, fig 1.
Calyptraea equestris, Sowerby, Thes Conchyl , V, 1883, p. 55, pl 445, figs 1 and 2.
Cheilea equestris, Thiele, Handbuch der systematischen Weichtierkunde, I, 1931, p 242.
Mitrularia equestris, Dautzenberg & Bouge, Journ. de Conchyl , LXXVII, 1933, p. 373.

This species is represented in the collection by one spirit specimen with all its soft parts intact, obtained on Krusadai Island in May, 1928, and another large dead shell taken on the beach of the Island recently. The shell is thick and moderately large, measuring about 22 mm. in height and 20 mm. in width at the broadest part of its base ; it is deeply bowl-shaped and rather asymmetrical, with a very wide, more or less circular aperture, and an apex placed very excentrically, almost directly over the posterior border of the base. The apex is marked by the presence of a minute, beak-like prominence which is slightly, but distinctly curved backwards. The surface of the shell is rough and irregularly convex ; there is a strongly marked sculpture of fine, raised, close-set radiating ridges which are somewhat sharp and keel-like, and the interstices between them are finely radiately striated, but this sculpture is obscured to a certain extent in the spirit specimen by the presence of small worm tubes and other encrustations ; the finer striae, however, are well seen in the dead shell, in which the surface is also thrown into strong, irregular, wrinkle-like spiral folds. The interior of the shell bears a rather large, more or less funnel-shaped, calcareous appendage suspended from the apex and unattached to the sides of the shell. The animal is said to live attached to some substratum by means of a large, concave, calcareous basal plate, but this plate is wanting in both the specimens and is likely to have been left behind while collecting. Externally the shell is of a dirty yellowish brown tint, but the interior is uniformly pure white and perfectly smooth. The tentacles are spindle-shaped, and these as well as the foot and the elongated siphon are clearly seen in the spirit specimen.

Mr. Winckworth regards that this species is so adaptable, varying according to the surface it adheres to, that a good number of Reeve's alleged species should be considered as synonymous with it. Krusadai Island.

Cheilea undulata (Roding).

Plate VI, figs 13*a* and 13*b*.

Patella undulata, Roding, Mus. Bolten, 1798, p. 4
Mitrularia neptuni, Schumacher, Essai, 1817, p 183 (not *Patella neptuni*, Dillwyn, 1817, also a *Cheilea*.)
Calyptraea dormitoria, Reeve, Conch Icon, XI, 1858, *Calyptraea*, pl. 11, fig 5.
Calyptra dormitoria, Sowerby, Thes Conchyl, V., 1883, p 56, pl 445, figs 19 and 20
Cheilea undulata, Hedley, Proc Linn. Soc, N S. W, XLVIII, 1923, p 309
Mitrularia dormitoria, Dautzenberg & Bouge, Journ de Conchyl., LXXVII, 1933, p 372

This species is slightly more frequently met with at Krusadai than the preceding one, but only dead shells have been collected so far. The shell is generally somewhat smaller, and much thinner than in *C. equestris*, and irregularly dome-shaped with an uneven and rather coarse-looking surface. It is sculptured with fine, close-set, radial striae which are more strongly marked than in the preceding species, and crossed by a few, rather widely separated spiral grooves. The height of the dome-shaped shell is considerably less than in *C. equestris*, and the apex is more centrally situated, somewhat blunter and less strongly curved than in that species. The internal appendage is proportionately smaller, curved, horse-shoe-shaped and not attached to the side of the shell. The specimens are in a somewhat worn condition (one of them having the apex completely worn down and flattened) and are white throughout. Krusadai Island, Pamban and Kundugal Point.

SERIES CALYPTRAEACEA.

Family CALYPTRAEIDAE.

The shell is either conical and cap-shaped, with a central or excentric pointed apex, or else flattened and plate-like; the shell is generally provided with an accessory appendage. The colour of the shell is normally white, but is sometimes pale brownish or greyish.

Two easily distinguishable genera, *Calyptraea* and *Crepidula* occur at Krusadai, and are each represented by one species known also from the Madras area. In the former, the shell is broadly conical, with a pointed and more or less central apex, while in the latter the shell is flattened, plate-like and elongately ovate, with a reduced, strongly depressed, almost terminal apex.

Genus **Calyptraea** Lamarck, 1799.

The shell is conical, with a wide, rounded aperture at the base and a more or less central apex, sometimes distinctly spiral, sometimes without whorls. The interior of the shell is provided with a folded appendage.

This genus includes the shells commonly known as crucible shells.

Calyptraea (Crucibulum) extinctorium Lamarck.

Plate VI, figs. 14*a* and 14*b*.

Calyptraea extinctorium, Lamarck, Anim. sans vert, (Deshayes' edit), VII, 1836, p. 622.
Crucibulum extinctorium, Reeve, Conch. Icon., XI, 1859, *Crucibulum*, pl. v, fig 14.
Crucibulum lividum, Reeve, ibid., pl. vii, fig. 24.
Crucibulum extinctorium, Crichton, Journ. Bomb Nat Hist Soc., XLII, 1941, p. 329.
Calyptraea (*Crucibulum*) *extinctorium*, Gravely, Bull. Mad. Govt. Mus (Nat Hist.), V, No. 2, 1942, p. 35.

This species is moderately common at Pamban, and numerous specimens have been collected, mostly from the mud flats at Kundugal Point, but no live specimen with the soft parts intact has been taken. The shell is somewhat thin, conical, with a sharply pointed, nearly central apex. The surface of the shell is very even, almost smooth and even slightly glossy, but very finely concentrically striated. The surface often tends to be rather concavely excavated on one side, the pointed apex being slightly inclined towards this side. The aperture is very large and more or less circular in outline. As in *Cheilea*, there is a folded internal appendage, but in this species it is more elongated, narrower, strongly laterally compressed and attached to the wall of the shell internally ; it is of interest to note that the side to which it is attached normally happens to be the side towards which the apex is inclined. The shell is whitish or pale horny brown frequently marked with oblique, radiating, wavy or interrupted reddish brown lines. The interior is generally smooth and polished. The proportion of the height of the shell to the diameter of its base varies considerably in different shells. Krusadai Island and Kundugal Point.

Genus **Crepidula** Lamarck, 1799.

The shell is usually elongately ovate, sometimes rounded, often very much flattened, with the apex almost or wholly marginal, and more or less beaked ; the lower side of the shell bears a horizontal septum which corresponds to the internal appendage of *Calyptraea*.

This genus includes the remarkable slipper-limpets.

Crepidula walshi Herrmannson.

Plate VI, figs. 15*a* and 15*b*.

Crepidula walshi, Herrmannson in Reeve, Conch Icon., XI, 1859, *Crepidula*, pl. iii, fig. 17.
Crepidula walshi, Tryon, Man Conch., VIII, 1892, p. 130, pl. 38, figs 56-58.
Crepidula (*Siphopatella*) *Walchii*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 201.
Crepidula walshii, Crichton, Journ. Bomb. Nat Hist Soc, XLII, 1941, p. 328
Crepidula walshi, Gravely, Bull. Mad Govt. Mus. (Nat Hist.), V, No 2, 1942, p. 35.

This species is considerably rarer than the foregoing, and only a few dead shells are contained in the collection. The shell is flattened, elongately ovate. plate-like with a small, almost obsolete marginal apex, which is slightly inclined. The upper surface of the shell is somewhat concavely depressed, and finely concentrically striated, the striae centering

round the excentric apex ; the upper aspect of the shell therefore strongly recalls the appearance of the operculum of a Gastropod shell with an excentric nucleus. On the lower side of the shell there is a horizontal, plate-like septum running parallel to the shell and attached to it along that portion of the margin where the apex is placed The lower surface of the shell is smooth and polished. The shell is whitish throughout. Pamban.

SERIES STROMBACEA.

Family XENOPHORIDAE.

The shell is shortly conical, with an umbilicus either open or filled up and with the basal margin strongly keeled, irregularly jagged, or with lamelliform processes. The shells generally bear pieces of coral, stones or Molluscan shells, firmly cemented on their upper surface. The aperture is very oblique, and the operculum large and horny. The snout of the animal is elongated and the foot divided into two parts This family includes the carrier shells.

The single genus of this family, *Xenophora,* is represented at Krusadai by a single species which is also known from Madras.

Genus **Xenophora** Fischer von Weldheim, 1807.

With the characters of the family.

Xenophora corrugata (Reeve).

Plate VI, figs. 16*a* and 16*b*.

Phorus corrugatus, Reeve, Proc Zool Soc. London, 1842, p. 163.
Phorus corrugatus, Reeve, Conch Icon., I, 1843, *Phorus* pl 1, fig 6
Xenophora corrugata, Fischer, in Kiener, Coq. Viv., XI, 1876, *Xenophora,* p 441, pl. 8.
Xenophora corrugata, Tryon, Man Conch., VIII, 1892, p. 159, pl 45, figs 81 and 82.
Xenophora corrugata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 203.
Xenophora corrugata, Gravely, Bull. Mad. Govt Mus (Nat Hist), V, No. 2, 1942, p. 35.

A single large shell from Krusadai Island is represented in the collection. The shell is broadly cone-shaped, with a considerably elevated apex, and flattened or even slightly concave basal surface. The surface bears a characteristic sculpture consisting of obliquely transpiral, somewhat wrinkled striae, close-set, and often irregularly directed. The basal surface is strongly reticulately sculptured with closely intercrossing, deeply curved radial, and concentric ridges, which are also strongly granular, especially towards the periphery. The outer surface of the shell bears, firmly cemented to it, more or less regularly arranged spiral rows of pieces of Gastropod shells, bivalves, stones, small solitary corals, etc., at the basal edge of each whorl ; these pieces are largest at the lowermost part of the shell and get successively smaller towards the apex where small bits of stone, etc., are more or less closely crowded

together. The aperture is strongly dorso-ventrally depressed and the thin, highly polished, whitish callus lining of the interior spreads outwards considerably over the exposed base of the body whorl ; the umbilicus is entirely filled in by the callus. The outline of the margin of the outer lip is deeply concave. The shell is whitish throughout, but the base is slightly tinged with pale yellow. The spiral rows of processes, so characteristic of the Madras species, *X. solaris*, are absent in this species. Krusadai Island.

Family STROMBIDAE.

The shell is so widely variable in shape and size that it is much easier to define this family by the characters of the soft parts than by those of the shell alone. The shell is either smooth or sculptured, with either a low, or well raised and turretted spire. The aperture is elongated and moderately narrow, its outer lip being generally everted into a wing-like expansion which may sometimes be produced into processes. The foot is narrow, laterally compressed, and enables the animal to progress by its strong, jerking movements. The operculum is horny, elongated, with a pointed tip.

Two genera, *Strombus* and *Pterocera* are known from the Pamban area. In the latter, the expanded outer lip of the aperture is drawn out at its free edge into a number of finger-like, grooved processes which correspond to processes of the mantle ; in *Strombus*, the outer lip is simply wing-shaped and not produced into processes.

Genus **Strombus** Linné, 1758.

The shell is variable in shape and size, with a spire which is sometimes low, sometimes tall and turreted, and consisting of numerous whorls ; the shell is as a rule distinctly sculptured with fine grooves or tubercles, but may be occasionally smooth. The outer lip of the aperture is thickened and everted.

The Pamban species of *Strombus* may be distinguished as follows :—

1. Shell large and body whorl very broad in proportion to height ; surface perfectly unsculptured, smooth, and polished, characteristically marked with fine, close-set, somewhat wavy, transpiral, orange-red lines ; outer lip very broadly expanded ... ... *S. canarium.*

— Shell not quite so large, body whorl narrower in proportion to height of shell and surface of shell not absolutely smooth and though sometimes glossy, distinctly sculptured with fine spiral grooves and ridges, and occasionally also with strong transpiral ribs ; colour-pattern not as above ; outer lip less broadly expanded 2

2. Edge of outer lip not appreciably thickened ; callus deposit on the columellar border thin and not separated off as a distinct, ridge-like elevation, smooth and polished ; angular shoulder, when present, somewhat keeled, but not tuberculated 3

—Edge of outer lip greatly thickened and raised into a stout, broadly raised swelling on the outer surface ; callus deposit on columellar border much thicker and raised into a more or less pronounced, ridge-like thickening, the surface of which is conspicuously transversely ridged throughout ; angular shoulder always present and strongly tuberculated (especially the one on the body whorl) 4

3. A strong, angular, somewhat keeled shoulder present on the whorls a little below the suture ; surface of shell with only finely impressed spiral grooves ; margin of outer lip entire towards the base ; apex sharp , shell with a characteristic colour-pattern of white spiral bands (marked with arrow-head-shaped brownish markings) on a brown ground colour ; upper portion of spire rather slender and acuminated Common ... . *S. marginatus.*

—Whorls without angular shoulders ; surface of shell with distinct, raised, close-set spiral ridges , margin of outer lip deeply notched towards the base ; upper portion of spire stouter and broader with a much blunter apex , colour not as above, usually whitish, tinged with yellowish brown and with deep purplish brown markings below the sutures. Considerably rarer .. . . *S. gibberulus.*

4. Shell rather narrow and elongate, with a strongly elevated and turretted spire , shoulders on the whorls sharply angular, well defined and more strongly nodular ; surface with strong transpiral ribs ; outline of the margin of outer lip rather strongly convexly arched .. .. *S. dentatus.*

—Shell broader and shorter, with the spire considerably wider and less elevated ; shoulders on the whorls not strongly angular and much less sharply defined ; nodules on the angles smaller and more feebly developed ; surface without strong transpiral ribs, glossy and finely spirally striated ; outline of the margin of outer lip straighter ... ... *S. urceus.*

Strombus marginatus Linné.

Plate VII, fig. 1.

Strombus marginatus, Linné, Syst. Nat., Ed. XII, 1767, p. 1209
Strombus marginatus, Reeve, Conch. Icon., VI, 1851, *Strombus*, pl. xviii, fig. 49.

This is by far the commonest species of Strombidae recorded from the Pamban area and numerous specimens, both dry shells and live specimens, have been collected especially from the mud flats at Kundugal Point. The shell is moderately large, often slightly glossy, with a large body whorl shaped more or less like an inverted cone, with its broad base abutting against the base of the spire. The spire is moderately short, with concavely depressed sides and a sharply pointed apex, its whorls being turretted, spirally grooved and transpirally plaited below the angle ; there are also one or two strong, whitish varices in the upper whorls of the spire. The body whorl is traversed throughout by regular, close-set spiral grooves which are stronger towards the base, and is strongly and angularly shouldered a little below the suture. The columellar border is covered by a polished, white callus which is faintly wrinkled above and below. The outer lip of the aperture is expanded and its upper end extends up over the surface of the spire for a considerable distance and terminates as a sharp, beak-like structure at about the level of the second whorl of the spire The aperture is narrow and linear and its outer lip closely wrinkled within. The shell is brownish, traversed by a few widely spaced, broad, spiral bands bearing brownish, often arrow-head-shaped markings on a white ground. Kundugal Point, Krusadai and Shingle Islands.

Strombus canarium Linné.

Plate VIII, fig. 2.

Strombus canarium, Linné, Syst. Nat., Ed. X, 1758, p. 745, No. 438
Strombus canarium, Kiener, Coq. Viv., IV, 1843, *Strombus*, p. 33, pl. 29, fig. 1.
Strombus canarium, Reeve, Conch. Icon., VI, 1851, *Strombus*, pl. xviii, fig. 46.
Strombus (*Gallinula*) *canarium*, Watson, " Challenger ", Zoology, XV, 1886, Gastropoda, p. 418.
Strombus canarium, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 146.
Strombus canarium, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 113.

The shell is larger and more massive than in the preceding species, and owing to the greater expansion of the outer lip, the body whorl is much broader in proportion to the height of the shell, its outline approaching roughly the shape of an equilateral triangle. The spire is relatively short, but the apex is sharp and pointed. The surface of the shell is smooth and glossy, but one or two of the uppermost whorls of the spire are finely spirally grooved. The expansion of the outer lip is more pronounced than in *S. marginatus*, and is broad and wing-like, its edge standing out at a considerable distance away from the inner border of the aperture. The callus deposit on the columella is white, polished, and considerably extensive. The whorls are smoothly rounded near the upper part, instead of being sharply angled as in *S. marginatus*. The shell is whitish or cream-coloured, profusely marked throughout with fine, close-set, irregularly wavy, transpiral, brownish or orange-brown lines ; the columella and interior of aperture are pure white. Krusadai Island and Pamban.

Strombus denatatus Linné.

Plate VII, fig. 3.

Strombus dentatus, Linné, Syst. Nat., Ed X, 1758, p. 745
Strombus plicatus, Kiener, Coq. Viv, IV, 1843, *Strombus*, p 62, pl 31, fig 1
Strombea plicatus, Kuster, Conch. Cab, Ed II, 1846, *Strombea*, p. 59, pl 13, figs. 3 and 4.
Strombus dentatus, Reeve, Conch Icon, VI, 1851, *Strombus*, pl ix, fig 17
Strombus (Canarium) dentatus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 151

The Pamban specimens in the gallery collection which have been originally labelled as *S. urceus, var. plicata*, Lamarck, seem on closer examination to be more correctly referable to the present species. The shell is rather narrow, elongate and spindle-shaped, with very sharply angulated whorls and a strongly elevated and markedly turretted spire. The angular shoulders on the whorls are strongly nodularly ribbed, these ribs extending downwards to the base on the whorls of the spire and also on the greater part of the body whorl adjoining the columellar border ; but on the outer half of the surface of the body whorl (i.e, towards the side of the outer lip), these ribs gradually take the shape of stout, angular tubercles and get confined more and more to the region of the shoulder This transpiral ribbing readily distinguishes this species from the remaining Pamban species. The basal portion of the body whorl is strongly and obliquely spirally grooved. The outer lip of the aperture is greatly thickened and raised into a stout, ridge-like elevation on the outer surface of the body whorl at the margin ; the surface of this thickening is strongly transversely ridged ; the lip is also slightly notched towards its anterior end. The callus deposit on the columella is thick, raised and ridge-like, its surface and the interior of the outer lip being finely transversely ridged. The outer surface of the shell is pale brownish, marked here and there with darker brown patches, while the interior of the aperture is dark orange-brown. Pamban.

Strombus urceus Linné.

Plate VII, fig. 4.

Strombus urceus, Linné, Syst, Nat, Ed X, 1758, p. 145, No. 440
Strombus floridus, Kiener, Coq Viv., IV, 1843, *Strombus*, p 63, pl 32, fig 1
Strombea floridus, Kuster, Conch Cab, Ed. II, 1846, *Strombea*, p. 53, pl 9.
Strombus floridus, Reeve, Conch Icon, VI, 1851, *Strombus*, pl vii, fig. 11
Strombus urceus, Watson, "Challenger", Zoology, XV, 1886, Gastropoda, p. 417 (note).
Strombus (Canarium) urceus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 152.

This species has long been known to authors as *S. floridus*, and much confusion has prevailed as to the correct use of the specific names *urceus*, *floridus* and *muricatus* ; but Schepman makes it perfectly clear that the Linnaean *urceus* is synonymous with *floridus* of Lamarck and Reeve and that the species in question should strictly bear the former name since it has priority over the latter.

This species is represented by two shells from Pamban in Mr. Crichton's collections. The shell is thick, with a somewhat polished surface, and slightly broader and shorter than in *S. dentatus* ; the spire is considerably broader and less strongly elevated ; the whorls are shouldered, but the shoulders are much less sharply angular and more or less smooth for the most part, except on the body whorl, where it bears three or four large, knob-like tubercles medially. The surface of the shell is smooth over the greater part, but finely transversely striated towards the outer margin of the body whorl (which is characterized by a broadly rounded ridge-like thickening of the outer lip), and sharply obliquely grooved towards the base of the body whorl. The aperture is narrow and elongate. The thickened outer lip is somewhat swollen near its upper end, deeply notched towards its lower end and finely transversely grooved on its inner surface. The callus deposit on the columella is very thick, raised and ridge-like and bears fine, close-set transverse grooves The shell is whitish, variegated with yellowish brown markings ; the interior of the aperture is beautifully pinkish. Pamban.

Strombus gibberulus Linné.

Plate VII, figs. 5*a* and 5*b*.

Strombus gibberulus, Linné, Syst. Nat, Ed. X, 1758, p 744, No. 433.
Strombus gibberulus, Kiener, Coq Viv, IV, 1843, *Strombus*, p 37, pl 28, fig. 1.
Strombea gibberulus, Kuster, Conch Cab, Ed II, 1846, *Strombea*, p 48, pl 8, figs. 3-9 and 11
Strombus gibberulus, Reeve, Conch Icon, VI, 1851, *Strombus*, pl. viii, fig 15.
Strombus (Canarium) gibberulus, Watson, "Challenger", Zoology, XV, 1886, Gastropoda, p 416.
Strombus (Canarium) gibberulus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 152.

Though this species is known to be very widely distributed, it was not recorded from Pamban until very recently, when a single, empty, but tolerably fresh and unworn shell was taken on the mud flats at Kundugal Point; Mr. Crichton's collection contains a larger shell from Tuticorin. The shell is very broadly spindle-shaped, tapering towards the base and apex,

the maximum width being a little below the suture between the body whorl and the spire. The whorls are evenly rounded and without angular shoulders. The whorls of the spire are rather unevenly inflated and bear one or two widely separated and irregularly disposed, broadly rounded varices. The margin of the whorls immediately adjoining the suture next above them is slightly thickened and the upper part of the body whorl towards the outer lip spreads upwards considerably, immersing to that extent the lower part of the spire as in *S. marginatus*. The spire is broadly conical with a fairly sharp apex. The surface is rather strongly transversely ridged throughout, and the interstices between the ridges often bear finer spiral striae. Sometimes the surface is partially smooth, this condition being well marked in Mr. Crichton's shell from Tuticorin in which the ridges are mostly confined to the outer and basal portions of the surface. The columella is covered by a thin callus deposit and is perfectly smooth. The outer lip bears a deep notch below and its interior is finely transversely wrinkled. The shell is pale yellowish white, mottled with brown, and with one or two purplish brown patches immediately below the sutures. The interior of the aperture is deep purplish. Kundugal Point.

Genus **Pterocera** Lamarck, 1799.

The shell is generally very thick and massive, with acuminated spire and strong sculpture; the outer lip is greatly expanded and produced into grooved processes; the columella and interior of aperture are sometimes smooth, sometimes strongly wrinkled.

Two species, *P. lambis* and *P. scorpius* are recorded from Pamban. In the latter, which is much rarer, the processes of the outer lip are comparatively short and strongly curved and the columella and interior of aperture are profusely wrinkled, while in the former, the processes are longer and less strongly curved, and the columella and interior of aperture are smooth and polished.

Pterocera lambis (Linné)

Plate VII, fig. 6.

Strombus lambis, Linné, Syst Nat, Ed X, 1758, p 743, No 425
Pterocera lambis, Kiener, Coq Viv, IV, 1843, *Pterocera*, p 7, pl iii, pl. ix, fig. 2
Pterocera lambis, Reeve, Conch Icon., VI, 1851, *Pterocera*, pl v, fig. 8
Pterocera lambis, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 152
Pterocera lambis, Hornell, Common Molluscs of South India, Mad. Fish Bull, XIV, 1921, p 114.

This is the commonest species of the genus and is abundantly represented in the Eastern seas. The shell is large, solid, and heavy, with a strongly sculptured surface which is frequently covered with a horny epidermis. The body of the shell proper, apart from the enormously expanded outer lip, is more or less spindle-shaped. The body whorl is provided with a strongly noduled, angular shoulder near the suture; a few nodules also occur lower down on the whorl. The surface is coarsely sculptured with close-set spiral ridges which occur in distinct groups of four or five on the body whorl, but all together on the whorls of the spire. The broadly expanded, wing-like outer lip of the aperture extends upwards at

the upper end over the surface of the spire almost up to the apex, and is prolonged at its outer edge into seven, elongated, finger-like, deeply channelled processes. The columella and the interior of the aperture are smooth and polished, sometimes white, sometimes pale flesh-coloured ; the outer surface is whitish, densely variegated with brownish markings. Only empty shells have yet been collected ; occasionally shells are found with the lip and processes completely broken off. In young specimens, the edge of the outer lip is very thin, and its processes are just indicated by depressions on the expanded part and are not produced much beyond its free edge. Pamban and Krusadai Island.

Pterocera scorpius (Linné).

Plate VII, fig. 7.

Strombus scorpius, Linné, Syst. Nat., Ed XII, 1767, p. 1208
Pterocera scorpio, Lamarck, Anim. sans vert., VII, 1822, p. 197
Pterocera scorpius, Reeve, Conch. Icon , VI, 1851, *Pterocera*, pl iii, fig. 3

This species is relatively rare, and represented in the Museum collection by a single specimen taken at Pamban. In many essential respects the shell resembles that of *P. lambis* ; the shell is smaller, but thicker and more solid ; the whorls are more strongly noduled and there are fine raised striae throughout the surface. The edge of the outer lip is straighter, somewhat nearer and more strictly parallel to the columellar border than in *P. lambis*. The outer lip is produced into seven finger-like processes of which the terminal ones are long while the lateral ones are shorter and more strongly curved ; the grooves in these processes are almost completely closed, and indicated only by narrow median slits on their inner surfaces ; the processes are conspicuously noduled. The columella and interior of aperture are strongly transversely ridged, the ridges standing out white on a pinkish violet ground colour which tints these parts ; the outer surface of the shell is cream-coloured, with brownish markings. Pamban.

SERIES NATICACEA.

Family NATICIDAE.

The shell is usually globular, but may be occasionally flattened with a much depressed spire ; the body whorl is inflated and large in proportion to the spire ; the columellar border is more or less strongly callous , the shell is usually umbilicated, but the umbilicus is sometimes completely filled up by callus, sometimes partly exposed as a crescentic depression. The operculum is usually horny with an excentric nucleus. A remarkable feature of the soft parts is the enormous development of the foot which is provided with a network of canals containing water.

The Krusadai species of Naticidae belong to four different genera, which may be distinguished as follows :—

1. Shell with spiral sculpture, which is sometimes faint and indistinct ; callus thickening on columella lip very feebly developed or absent altogether, *or* shell with flattened spire	2
—Shell not flattened, but globular or ovoid, with more strongly elevated spire ; smooth, without spiral sculpture ; callus thickening on columella lip present, often very well developed	3
2. Shell generally very much flattened, with a markedly depressed spire ; umbilicus narrow or closed ; columella lip of aperture often distinctly arched ...	*Sinum*. (= *Sigaretus*).
—Shell not flattened and spire not depressed ; umbilicus present and open ; columella lip of aperture straight.	*Eunaticina* (=*Naticina*).
3. Body whorl much inflated, more or less globular, but not obliquely elongated ; surface of shell smooth or finely striate, but rather dull and rarely highly polished ; umbilicus generally partially open ...	*Natica*.
—Body whorl very large in proportion to the reduced spire, and markedly oblique ; surface of shell smooth and highly polished ; umbilicus generally completely filled up by callus	*Polynices* (=*Albula*).

Of these four genera, the genus *Natica* comprises by far the greatest number of species of this family recorded from Krusadai.

Genus **Natica** Scopoli, 1777.

The shell is rounded, usually smooth, sometimes with faint radial striae below the sutures, seldom strongly sculptured, often brightly coloured ; the umbilicus is usually reduced by callus deposit, sometimes almost open. The operculum bears a calcareous deposit.

The eight species of *Natica* known from Krusadai may be distinguished as follows :—

1. Shell small, solid, lower part of body whorl somewhat concavely excavated and angled round the base ; shell bluish white, marked throughout with irregular reddish brown lines	*N. traillii*.

—Shell not as above, generally larger, and coloured differently 2

2. Spire very much depressed, the elevation of the first whorl of the spire above the level of the body whorl being very slight, almost imperceptible. Body whorl large and tending to be somewhat compressed antero-posteriorly ; whorls of spire not inflated ... 3

—Spire comparatively raised, the elevation of the first whorl of spire above the level of the body whorl being well marked ; body whorl more rounded and globose ; whorls of spire inflated 5

3. Shell encircled with broad pale spiral bands ; callosity (i.e., callus deposit on columellar border of aperture) without surface groove, whitish, and partly filling the umbilicus ... ... *N. albula.*

—Shell without distinct, continuous spiral bands as in the above ; callosity of a deeper or lighter brownish colour and divided into an anterior and a posterior portion by a well marked surface groove ... 4

4. Anterior part of columellar callosity almost equal in size to or even a little larger than the posterior part ; callosity recurved ; umbilicus widely open ... *N. lamarckii.*

—Anterior part of columellar callosity much smaller than the posterior part which is fused throughout its extent to the body whorl, thus partly closing the umbilicus ; height of body whorl proportionately smaller ... ... *N. didyma.*

5. Shell rather small in average size ; umbilicus filled up by callus for the most part, and seen as a small crescent-shaped depression 6

—Shell larger and thicker, umbilicus wide open, and seen as a deeply excavated pit, which extends round the strong callus thickening at the base of the columella as a well marked, curved groove ... 7

6. Shell of a dull greyish or ashy green colour ; spiral markings usually absent, or, if present, very obscure ;

a narrow whitish or pale spiral zone present just below the suture ; interior of aperture usually purplish ; very common ... ... *N. marochiensis.*

—Shell pale brownish, profusely marked all over with numerous dark purplish brown spots which sometimes tend to coalesce with one another , spiral zone next below suture not particularly whitish ; interior of aperture white ; rare ... ... *N. tigrina.*

7. Shell white, smooth and highly polished, with a characteristic colour pattern consisting of numerous, rather fine, close-set, transpiral, orange-red wavy lines on a white ground ... ... *N. lineata.*

—Shell white, smooth, but surface not particularly glossy, marked with a few somewhat widely spaced spiral lines, each of which is made up of a number of alternating segments of white and dark brown, the latter being generally narrower ... ... *N. ala-papiliones.*

Natica marochiensis Gmelin.

Plate VIII, figs. *1a* and *1b*.

Natica marochiensis, Gmelin, Syst Nat , Ed. XIII, 1791, p 3673
Natica marochiensis, Lamarck, Anim. sans vert., VI, (2), 1822, p. 203.
Natica marochiensis, Reeve, Conch. Icon , IX, 1855, *Natica*, pl. xiii, fig. 52.
Natica marochiensis, Tryon, Man. Conch., viii, 1892, p 22, pl v, figs 74 and 75
Natica marochiensis, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 208.
Natica marochiensis, Gravely, Bull Mad. Govt Mus (Nat. Hist.), V, No. 2, 1942, p. 37.

This is the commonest species of *Natica* recorded from the Pamban area, and numerous dead shells as well as living specimens have been collected, the latter being particularly abundant in certain areas on the mud flats at Kundugal Point. In fresh shells the surface is somewhat glossy. The callus deposit on the columella is thick, whitish, highly polished and fills up the greater part of the umbilicus, reducing the latter to a crescent-shaped opening. The surface bears minute transpiral striae which are strongly oblique immediately below the suture. The aperture is semilunar, and the operculum calcareous and externally granular. The shell is generally uniformly dull greenish brown ; occasionally there may be a few spiral rows of brownish arrow-head-shaped spots, but even these are often obscured and indistinct. The egg case of this species is in the form of a ribbon curved in the shape of an open ring, with closely agglutinated sand particles ; such capsules are frequently found on the shore. Krusadai Island and Kundugal Point.

Natica albula (Röding).

Plate VIII, fig. 7.

Cochlis albula, Röding, Mus. Bolten., 1798, p 146.
Nerita rufa, Born, Index Mus. Vindobon, 1778, p 413.
Nerita rufa, Born, Testacea, Mus Vindobon, 1780, p 398, pl 17, figs 3 and 4.
Natica rufa, Lamarck, Anim. sans vert., (Deshayes' edit.), VIII, 1838, p. 639.
Natica rufa, Reeve, Conch. Icon, IX, 1855, *Natica*, pl xvi, fig. 70.
Natica rufa, Schepman, Siboga-Expedite, Prosobranchia, Monogr. XLIX, 1908, p. 211.
Natica albula, Gravely, Bull. Mad. Govt. Mus (Nat Hist), V, No. 2, 1942, p. 37.

This species, better known as *Natica rufa*, is represented in the collection by a single rather worn specimen collected from Krusadai by Mr. Crichton. The shell is fairly large, thick and solid with an inflated body whorl and a greatly reduced spire. The surface is finely obliquely striated. The columella is covered by a thick, smooth and polished callus deposit which is fused with the body whorl for a little distance posteriorly, but separated from it anteriorly, thus leaving the umbilical opening free in this part. The aperture is semicircular. The shell is pale reddish brown marked with a broad, pale spiral band about the middle ; the basal part of the body whorl and the region next below the suture are whitish. Krusadai Island.

Natica tigrina (Röding).

Plate VIII, fig. 2.

Cochlis tigrina, Röding,, Mus. Bolten., 1798, p. 147.
Natica maculosa, Lamarck, Anim sans vert., (Deshayes' edit.), VIII, 1838, p. 641.
Natica maculosa, Reeve, Conch Icon., IX, 1855, *Natica*, pl. xiii, fig. 57
Natica tigrina, Gravely, Bull. Mad Govt. Mus. (Nat. Hist), V, No. 2, 1942, p 37.

The shell is smaller in average size than that of *N. marochiensis*, and may at once be distinguished from the rest by its characteristic colouration. The body whorl is inflated and globular ; the general proportions of the shell and the shape of the umbilicus are very much the same as in *N. marochiensis*. The callus is very thick, especially at the base of the columella. The shell is pale brownish, dotted all over with small, close-set, rounded purplish brown spots which are for the most part arranged in regular spiral rows ; but this regularity is sometimes lost, the spots of one row coalescing with those of the adjacent ones. Pamban.

Natica traillii Reeve.

Natica traillii, Reeve, Conch. Icon., IX, 1855, *Natica*, pl. xxix, fig. 137.
Natica traillii, Sowerby, Thes. Conchyl., V, 1883, *Natica*, p. 462, pl. ix, fig. 164.
Natica traillii, Melvill and Standen, Proc. Zool. Soc. London, 1901, p. 359.
Natica traillii, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 37.

This species is somewhat rare, and represented in the collection by only two dead shells from Pamban. The shell is small, just about the same size as that of *N. marochiensis*, solid

and globular with a small flattened spire and inflated body whorl. The basal portion of the body whorl is somewhat depressed and bears a deep umbilicus, a greater part of which, especially posteriorly, is covered up by a large, polished, chestnut, callus deposit. The shell is whitish, or pale bluish grey, marked throughout with irregularly wavy, reddish brown transpiral lines ; a narrow spiral zone next below the suture tends to be paler than the general ground colour. Pamban.

Natica ala-papilionis (Röding).

Plate VIII, fig. 3.

Cochlis ala-papilionis, Roding, Mus Bolten, 1798, p. 146.
Nerita ala-papiliones, Chemnitz, Conch Cab, V, 1840, p 257, figs. 1868—1871.
Natica ala-papiliones, Reeve, Conch Icon, IX, 1855, *Natica*, pl. xvi, fig 60.
Natica ala-papiliones, Gravely, Bull. Mad. Govt Mus (Nat. Hist), V, No. 2, 1942, p. 37

This species is represented in the collection by only a single Krusadai specimen, but is relatively common in the Madras area The shell is moderately large, with an inflated body whorl somewhat broadly expanded towards the aperture, and a slightly elevated spire. The part of the surface immediately below the suture is strongly obliquely striated The umbilicus is large, and a large, extensive, spirally thickened callus deposit enters it from the columellar border of the aperture. The shell is pale brownish, marked with four widely separated white spiral lines (or rather, narrow spiral bands) each of which is interrupted by a number of squarish or rectangular dark brownish spots. Krusadai Island

Natica lineata Lamarck.

Plate VIII, fig. 4.

Natica lineata, Lamarck, Anim sans vert, (Deshayes' edit), VIII, 1838, p. 640.
Natica lineata, Reeve, Conch Icon., IX, 1855, *Natica*, pl vii, fig. 24.
Natica lineata, Tryon, Man Conch, VIII, 1892, p 29, pl ix, figs 62 and 63.
Natica lineata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 211
Natica lineata, Gravely, Bull Mad. Govt Mus (Nat. Hist), V, No 2, 1942, p 37.

The shell is moderately large, with an inflated body whorl, a slightly elevated spire and a more or less sharply pointed apex ; it is comparatively thin, with a smooth and finely glossy surface when fresh. The aperture is large and the operculum calcareous. The umbilicus is large and deep ; the columella is thin, but provided with a stout callosity which enters spirally inwards into the umbilical depression. The most characteristic feature of the shell, however, is its distinctive colour pattern ; it is ashy white, marked throughout with close-set, transpiral, wavy, deep yellow or orange lines ; the whorls of the spire are often partially tinged with pale bluish grey. Three shells are represented in the collection, two of which are rather faded, while all have the edge of the outer lip slightly broken. Pamban.

Natica didyma (Röding).

Plate VIII, fig. 5.

Albula didyma, Röding, Mus. Bolten., 1798, p. 20.
Natica chemnitzii, Récluz, MS , Chenu, Illus. Conch , 1843, *Natica*, pl. iii.
Natica chemnitzii, Reeve, Conch. Icon., IX, 1855, *Natica*, pl. ii, fig. 7.
Natica didyma, Crichton, Journ. Bomb. Nat Hist. Soc., XLII, 1941, p. 333.
Natica didyma, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 37.

The shell is somewhat large and thick, with a smooth and glossy surface, but devoid of any conspicuous colour markings. The surface is finely transpirally striated throughout. The spire is very small in proportion to the large, inflated body whorl, being almost completely depressed. The columellar border bears a large, transversely expanded, curved callosity, divided by a transverse groove into a large posterior portion which is fused throughout its length to the body whorl and thus closing the umbilicus partly, and a much smaller anterior portion with a free edge ; the outer surface of the shell is more or less uniformly pale brownish or greyish, while the callosity and interior of aperture are deep chestnut. Pamban and Shingle Island.

Natica lamarckii Chenu.

Plate VIII, fig. 6.

Natica lamarckii, Chenu, Illus. Conch., 1843, *Natica*, pl ii.
Natica lamarckii, Récluz, MS , Chenu, Illus. Conch., 1843, *Natica*, pl ii.
Natica lamarckiana. Reeve, Conch Icon , IV, 1855, *Natica*, pl ii, fig 6.
Natica lamarckii, Gravely, Bull. Mad Govt Mus (Nat Hist.), V, No. 2, 1942, p 37.

In size and general appearance the shell of this species closely resembles that of the preceding, but the body whorl is proportionately higher, and the spire less markedly depressed. The umbilicus is deeply excavated and widely open for the most part. The columellar callosity is broad and divided into an anterior and a posterior part as in the preceding species ; but in this species the anterior part is as large as, or even slightly larger than the posterior part, while the tip of the callosity pointing towards the body whorl is strongly recurved. The shell is uniformly greyish or pale brownish, but faint, pale spiral bands may often be made out. The callosity is dark chestnut. Kundugal Point.

Of the species of *Natica* recorded from Krusadai, all except *N. marochiensis* are represented in the collection only by dead shells, but it is by no means improbable that living specimens of the other species also will be found in the locality by further collection.

Genus Polynices Montfort, 1810.

(Syn. **Albula** Bolten, 1798).

This genus is closely allied to *Natica* and is not separated as a distinct genus by some authors. The body whorl is strongly oblique and relatively less strongly inflated. The aperture is semilunar, and the operculum horny.

This genus is represented by a single species, *P. mamilla*, which is a fairly widely distributed species, being the commonest member of the genus and known also from the Madras area.

Polynices mamilla (Linné).

Plate VIII, fig. 8.

Nerita mamilla, Linné, Syst. Nat, Ed X, 1758, p. 776, No. 627
Natica mamilla, Reeve, Conch Icon, IX, 1855, *Natica*, pl. vii, fig. 27.
Natica mamilla, Tryon, Man Conch., VIII, 1892, p 49, pl xvi, fig. 46
Polinices mamilla, Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, 1906, p 616
Natica (Mamma) mamilla, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 215.
Natica mamilla, Hornell, Common Molluscs of South India, Mad. Fish Bull, XIV, 1921, p. 119.
Albula mamilla, Gravely, Bull. Mad. Govt Mus (Nat. Hist), V, No. 2, 1942, p 38.

This species is common in the Pamban area, and numerous specimens, both dead shells and live specimens have been collected ; the latter generally live in soft sand, where they may be seen crawling on the surface or burrowing. It is easily distinguished from the other recorded species of Naticidae by its smooth, polished, ivory-white shell with a greatly reduced spire and a large, markedly oblique body whorl which gives the shell an elongately ovoid shape. The body whorl is less strongly inflated than in species of *Natica* generally. The aperture is semicircular and obliquely inclined The columellar border of aperture bears a very thick, broad, whitish, polished callus deposit which completely fills up the umbilicus ; the outer edge of the callosity is marked off by a distinct groove separating it from the surface of the body whorl proper. The shell is thick, solid and pure white throughout. Pamban, Kundugal Point, Krusadai and Shingle Islands.

Genus **Sinum** (Bolten) Röding, 1798.

(Syn. **Sigaretus** Lamarck, 1799).

The shell is generally very much flattened, with a strongly depressed spire, usually white, smooth, or finely spirally striated. The umbilicus is rudimentary or even closed altogether. The operculum is small and horny. The foot is very large and elongated.

Two species, *S. planulatum* and *S. neritoideum*, have been recorded. In the former the spire is completely flattened and the shell is very strongly depressed and practically flat, being nearly about thrice as broad as high, while in the latter the spire is distinctly exserted and visible in profile and the shell is much less markedly depressed, being only about twice as broad as high.

Sinum planulatum (Récluz).

Plate VIII, fig. 9.

Sigaretus planulatus, Récluz, Illus. Conch., *Sigaretus*, 1843, p. 21, pl. iii, fig. 4.
Sigaretus planulatus, Reeve, Conch Icon, XV, 1864, *Sigaretus*, pl. ii, fig. 7.
Sinum planulatum, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No 2, 1942, p. 39

This species is represented in the collection by two Pamban specimens with their soft parts intact. The foot is thick, fleshy, enormously developed, elongated and fully exposed. The shell is very much flattened, with a flatly depressed, almost obsolete spire, resembling somewhat that of *Haliotis* in shape, and partially or almost wholly embedded in two large, thick, enveloping lobes of the mantle. The surface of the shell is very finely spirally striated, the striae being crossed by faint, close-set transpiral grooves. The aperture is very large, and bounded on the inside by an arched columella lip. The shell is white, covered with a distinct pale yellowish periostracum. Kundugal Point and Krusadai Island.

Sinum neritoideum (Linné).

Plate VIII, fig. 10

Helix neritoidea, Linné, Syst Nat., Ed. XII, 1791, p. 1250
Sigaretus neritoideus, Reeve, Conch. Icon., XV, 1864, *Sigaretus*, pl 1, fig 5
Sinum neritoideum, Gravely, Bull Mad Govt Mus (Nat Hist), V, No. 2, 1942, p. 38.

A single empty shell from the Kundugal beach is represented in the collection. The shell is somewhat depressly ovoid, with a large ovately inflated body whorl and a comparatively small and reduced spire, which, however, is definitely exserted and visible in profile from behind as a small convex prominence, raised above the level of the body whorl, and situated almost terminally. The body whorl is much less strongly depressed than in the preceding species and appears considerably higher in a view from behind. The shell is rather thin, with a glossy interior, but the outer surface is closely spirally striated and finely transpirally plicated. The aperture is large and broadly ovate, and the columellar surface which bears a callus deposit, is only slightly arched. The umbilicus is open and assumes the form of a deep, elongated depression. The shell is white almost throughout, but stained with orange brown over the columella and umbilicus. The shell in the collection being slightly worn, lacks the characteristic yellowish brown periostracum. Kundugal Point.

Genus **Eunaticina** P. Fischer, 1885.

(Syn. **Naticina** Gray, 1842).

This genus is more or less intermediate between *Natica* and *Sinum* in shell form. The shell is not depressed, but pear-shaped with a moderately elevated spire and spirally striated surface. An umbilicus is present and the columella lip is straight.

A single species, known also from Madras, and represented in the collection by a pair of dead shells from Pamban, has been recorded.

Eunaticina papilla (Gmelin).

Plate VIII, fig. 11.

Nerita papilla, Chemnitz, Conch. Cab., V, 1840, p. 285, pl. 189, fig 1939.
Sigaretus papilla, Reeve, Conch. Icon., XV, 1864, *Sigaretus*, pl. iv, fig. 19.
Eunaticina papilla, Gravely, Bull. Mad Govt. Mus (Nat. Hist.), V, No. 2, 1942, p. 38.

The shell is moderately small, with a more or less oblique, inflated body whorl, and a short but distinctly elevated spire. The suture between the body whorl and the spire is set in a shallow groove so as to give the spire the appearance of being slightly pinched off from the body whorl. The surface of the shell is traversed throughout by fine, regular, evenly spaced spiral grooves, and by faint, minute, transpiral striae, the latter being seen clearly only under the lens. The aperture is large, ovate, narrower posteriorly. The columellar lip is straight, bears a thin deposit of callus, and bounds a moderately deep umbilicus. The shell is whitish, but remains of a thin, yellowish brown periostracum can be made out in the specimens examined. The interior of the aperture is pure white. Pamban.

SERIES CYPRAEACEA.

Family CYPRAEIDAE.

This is a large and important family comprising the shells popularly known as cowries, and is well represented in the Indian waters. The shells are noted for their exquisitely polished surface and the wide range of variation in the pattern of their colouration. The shell is " inrolled ", that is to say, the body whorl and the outer lip of the aperture are rolled inwards into the interior of the shell in such a manner that the aperture assumes the shape of a long, narrow, slit extending lengthwise from end to end, the spire consequently becoming internal and concealed ; in young specimens, however, the spire is exposed. The two margins of the aperture are usually toothed. The mantle is reflected over the outer surface of the shell during life. An operculum is absent.

This family is represented at Krusadai by two principal genera, *Cypraea* and *Ovulum* (=*Radius*) of which the former comprises the vast majority of recorded Cypraeidae. The genus *Cypraea* has been split up into numerous genera and sub-genera by specialists, notably Drs. F. A. & M. Schilder in their " Monograph on Living Cypraeidae "[1] ; but for our purpose it would be convenient to retain the generic name *Cypraea* for the sub-sections of the genus as well, for most of the characters on which Drs. Schilder base their classification relate to the radula and cannot be satisfactorily studied without the requisite technique ; the synonymous equivalents of the Krusadai species in their system of classification, however, are indicated in the list of references prefixed to each specific description.

In the genus *Cypraea*, both the columella lip and the outer lip of the aperture are strongly toothed, the lower part of the columella is more or less straight, and the shell is usually strongly

[1] Proc. Malac. Soc. London, XXIII, 4, March 1939, pp. 119—231.

inflated, not much elongated, and without the extremities being produced ; while in *Ovulum*, the outer lip is toothed, but the columella lip is smooth and sinuate near the anterior end, and the shell is often, though not invariably, more elongate, spindle-shaped and produced at the extremities to a greater or less extent.

Genus **Cypraea** Linné, 1758.

The shell is usually large, ovoid, inflated, smooth, with both the outer lip of aperture and the columella lip conspicuously toothed. The shell bears a wide fossula. In young shells, which are very thin and fragile, the spire is exserted, the aperture considerably wider and the outer lip simple and without teeth.

Twenty-three species of *Cypraea* have so far been recorded from Pamban, but it is quite probable that many more species will be found to occur by further intensive collection in this area, as Schilder's distribution map indicates no less than forty-seven species of Cypraeidae as occurring in this locality and its immediate neighbourhood.

Of the recorded species, many are represented only by dead shells in the Museum collection, while some are represented solely by Pamban shells contained in Mr. Crichton's collection. As there is very little difference between the shells of the several species except in their colour and colour patterns, the following key had to be necessarily based mainly on colour characteristics, though features relating to the shape of the shells have been taken into account wherever they are distinctive ; and, when the specimens are fresh, they may be easily referred to their respective species with the aid of this key. In bleached and worn out shells, however, the surface layer gets rubbed off and with it the colour also disappears ; in such cases, the identification should necessarily involve comparison of the specimen in question with fresher and less worn ones and fitting it in series of the latter :—

1. A definite colour pattern in the form of variously shaped spots, markings, blotches, reticulations or bands present ; colour generally somewhat dark ... 3

— Shell more or less uniformly white or yellowish, but generally a narrow, pale-coloured marginal area present, readily distinguishable from a large relatively darker central area 2

2. Shell whitish, or more usually yellowish, rather broad, and with a more or less rhomboid outline ; marginal area pale and bearing a somewhat indistinct nodule at the angular part on the sides ; central area more deeply coloured, usually bright yellowish, and in

fresh shells separated from the marginal zone by a reddish line ... . *C. moneta.*

— Shell much smaller, proportionately narrower, margin more evenly rounded ; marginal area whitish, without any nodule-like swelling at the sides ; central area bluish grey ... ... *C. annulus.*

3. Dorsal surface of shell with raised white granules (which may sometimes be replaced by mere white spots) ; teeth of the columella and outer lip produced across the entire basal surface as transverse ridges or wrinkles .. . . *C. staphylaea.*

— Dorsal surface of shell smooth, not raised into granules ; teeth bordering the aperture confined to the columellar and labial borders, or at most only partially produced 4

4. Dorsal surface of shell marked with irregular spots, blotches, mottlings, or variously shaped markings, and sometimes with broad, transverse bands in addition to these markings 8

— Dorsal surface of shell without spots or blotches, but only with distinct, broad, pale or dark-coloured transverse bands or zones 5

5. Shell considerably large, rather elongate ; sides and basal surface dark chestnut or blackish brown ; dorsal surface of shell pale yellow with two or three broad, pale brownish transverse bands ... ... *C. talpa.*

— Shell much smaller, proportionately less elongated, not with the above characteristic colouration ... 6

6. Shell moderate-sized, transverse bands on dorsal surface usually whitish or pale-coloured on a darker background 7

—Shell very small, about the size of *C. annulus*, whitish, with three very conspicuous, broad, blackish brown bands on the dorsal surface, reducing the white ground between them to relatively narrow zones ... ... *C. asellus.*

7. Shell generally dark brown, with two very widely spaced, indistinct, pale, transverse bands on the dorsal

surface ; teeth on the columella and outer lip yellowish, and interstices brownish ... ... *C. onyx.*

— Shell pale flesh-coloured, dorsal surface ornamented with four or five indistinct pale reddish brown transverse bands ; teeth on the columella and outer lip, and the interstices between the teeth violet ... ... *C. carneola.*

8. Shell ornamented with definite rounded sopts or dots, which may sometimes be distinct, sometimes rather clouded, either closely or widely set ; blotches or other irregular markings sometimes present in addition to the spots 9

— Shell without definite rounded spots or dots, but often mottled or ornamented only with irregular blotches, small broken stripes or network-like markings ... 15

9. Spots small, numerous and close-set, whitish or pale-coloured on a darker background which is generally yellowish, dark chestnut-brown or greenish brown ... 10

— Spots larger, usually relatively less in number and more widely spaced, dark-coloured ; generally chocolate brown or blackish brown on a paler background, which may either be plain or else variously mottled or blotched 13

10. Dorsal surface of shell pale yellowish ; dots white, rounded, and many of them with a conspicuous, dark reddish brown central spot which gives them the appearance of small 'eyes' ; margin of shell obscurely spotted ... ... *C. ocellata.*

— Dorsal surface of shell generally much darker in colour ; dots white or pale bluish white, none of them having a central spot ; margin and basal surface of shell unspotted 11

11. Shell with a broad, unspotted, dark brown margin all round ; dots very numerous and confined to the central area bounded by the unspotted margin ; dorsum of shell somewhat strongly humped ; outline of base very broadly ovate ... ... *C. caput-serpentis.*

— Dorsal surface of shell spotted throughout, without any distinct unspotted marginal zone; dots less numerous and more widely separated; dorsum of shell relatively less elevated and scarcely humped; outline of base less broadly ovate 12

12. Dorsal surface of shell moderately dark brownish; spots whitish, many of which are encircled by dark brownish ring-like markings; basal surface of shell uniformly violet ... ... *C. poraria.*

— Dorsal surface of shell pale yellowish brown or greenish brown marked with pale bluish white spots which are without dark-coloured ring-like edges; basal surface of shell whitish; outer lip somewhat thickened and strongly toothed throughout its width, some of the teeth even extending round the margin on to the dorsal side of the shell ... *C. erosa.*

13. Shell very large and elongated; dorsum of shell slightly flattened about the middle; surface profusely marked all over with minute white dots in addition to the large, clouded, blackish brown spots and blotches; basal surface of shell pale fleshy brown ... *C. testudinaria.*

— Shell generally smaller, occasionally as large, but always much less elongate in proportion to the width; dorsum of shell more convexly arched and evenly rounded about the middle; surface without minute white dots, but with rounded, blackish or brownish spots on a plain or mottled background; basal surface of shell whitish ... 14

14. Shell rather large with the basal surface somewhat concavely depressed; dorsal surface whitish, marked with numerous close-set blackish brown round spots with their indefinite edges often clouded with bluish white. Interstices between the teeth whitish ... ... *C. tigris.*

— Shell much smaller; dorsal surface mottled throughout with clouded bluish and brownish markings interspersed at wide and irregular intervals with

variously sized, rounded, dark brown spots; interstices between the teeth bright orange-red ... *C. lynx.*

15. Shell moderately large, dorsal surface brownish or of a cloudy, bluish brown tinge, ornamented with longitudinal rows of very characteristic dark brown markings which simulate the characters of an unknown script, these markings sometimes coalescing so as to leave clear, rounded spaces of the ground colour; lower lateral edges of the shell slightly thickened with callus and marked with blackish brown spots; common ... ... *C. arabica.*

— Shell generally smaller; colour and pattern of colouration not as above, the characteristic hieroglyphic markings being absent; as a rule rarer ... 16

16. Teeth on the outer lip confined to its edge adjoining the aperture, and not extending as definite transverse ridges across the basal surface of the thickened lip; lower lateral margins of the shell usually, though not invariably, unspotted 17

— Teeth on the outer lip stronger and extending across the ventral surface of the thickened outer lip as definite transverse ridges; lower lateral margins of the shell usually irregularly spotted with brown ... 20

17. Shell somewhat cylindrically shaped and elongate, pale ashy brown or cream-coloured, traversed by two or three very faint, indistinct pale transverse bands, and marked with fine, blackish, irregularly broken, longitudinal stripes and dashes; anterior and posterior ends tinted bright orange-red ... ... *C. isabella.*

— Shell not so narrow and cylindrically elongate; broader and more or less ovate in outline; pale transverse bands generally absent in adult shells; pattern of markings not as above and anterior and posterior ends more sombrely coloured 18

18. Shell bluish green, profusely freckled throughout with minute brownish markings and usually with a

dark brown central blotch on the dorsum ; lower lateral margins with a slight callus thickening ... 19

—Shell paler, freckled throughout with larger brownish markings either with or without a central blotch on the dorsum ; lower lateral margins without callus thickening, but sometimes sparingly spotted ... 20

19. Shell moderate-sized, rather elongate in proportion to the breadth ; brownish markings bolder and more in the form of irregular freckles than regular rounded dots ; central blotch diffuse and irregular ; sides and base yellowish white, unspotted ... .. *C. errones.*

—Shell small, pear-shaped, less elongate in proportion to its width ; ground colour of dorsum darker greyish ; brownish markings very minute, but in the form of definite dots ; central blotch more or less in the form of an irregular brownish transverse band across the dorsum ; sides and base whitish, sparingly spotted with brown ... ... *C. gracilis.*

20. Shell rather small, hardly exceeding three-quarters of an inch in length, somewhat elongately ovate ; inner set of teeth extending across the columella ; a pair of dark violet spots present at each extremity of the dorsal surface ... ... *C. fimbriata.*

—Shell larger, well over an inch in length, thinner ; dorsal surface of shell paler ; shell more broadly ovate in outline, more or less pear-shaped ; inner set of teeth not extending across the columella ; shell without the characteristic terminal violet spots of *C. fimbriata* ... ... *C. pallida.*

21. Shell small, pale bluish grey, usually with two widely spaced, irregularly shaped, and often broken, white transverse bands across the dorsum, but not quite its entire extent and also with a few scattered minute brownish dots ; two conspicuous blackish brown spots on each side at the extremities ... ... *C. hirundo.*

—Shell larger, dorsal surface whitish, irregularly freckled with numerous brownish or yellowish brown

specks and markings ; lower lateral margins of the shell usually more boldly spotted ; extremities without well defined rounded spots on each side ... 22

22. Shell somewhat elongately ovate ; dorsum not much elevated ; lateral margins of the shell usually thickened by a whitish callus deposit, which is smooth, polished and marked with large, round, brown spots ; teeth on lips very strongly developed ... ... *C. caurica*[1].

—Shell shorter and more broadly ovate in outline ; dorsum relatively more elevated ; lateral margins of shell not thickened by callus, but marked with smaller and less distinct brown spots ; teeth on lips less strongly developed ; dorsal surface of shell usually with zig-zag brown markings ... ... *C. lentiginosa*.

As the members of the genus *Cypraea* form a rather homogeneous group so far as the basic characters of the shell are concerned, and as the small differences between the various species relate mainly to the colour and colour-patterns and to a less extent to the size and proportions of the shells, many of the more essential ones of which have already been mentioned in the foregoing key, the following descriptions have had to be necessarily made much briefer than the fuller descriptions given for the species of other genera generally. The Pamban species of *Cypraea* are arranged below in the order in which they are dealt with by Drs. F.A. and M. Schilder in their Monograph on Living Cypraeidae. The length in millimetres of an average adult shell of each species is given at the end of the description.

(Genus **Staphylaea** Jousseaume, 1884.)

Cypraea staphylaea Linné.

Plate IX, fig. 1.

Cypraea staphylaea, Linné, Syst. Nat., Ed. X, 1758, p. 725, No. 324.
Cypraea staphylaea, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl. xvi, fig. 82.
Cypraea staphylaea, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 136.
Staphylaea staphylaea, Schilder, Proc. Malac. Soc., XXIII, pt. iii, 1938, p. 129.

Five shells are represented in Mr. Crichton's collection. The colour of the dorsal surface ranges from a bright greyish brown to a pale ashy blue or greyish blue ; the surface is ornamented with numerous small, whitish, raised granules, but these sometimes become

[1] There is a specimen from the British Museum in Mr. Crichton's collection, in which the sides are not thickened ; this is only an individual variation occasionally met with in the species.

obsolete and are replaced by mere white spots ; two shells out of the five exhibit this latter condition. The teeth on the lips are produced as strong transverse ridges on the basal surface of the shell throughout its width and many of these ridges often become bifid before they reach the outer margins. The extremities are coloured dark orange-brown. 16 mm. Pamban.

(Genus **Erosaria** Troschel, 1863).

Cypraea caput-serpentis Linné.

Plate IX, figs. *2a* and *2b*.

Cypraea caput-serpentis, Linné, Syst Nat, Ed X, 1758, p 720, No. 298.
Cypraea caput-serpentis, Reeve, Conch Icon, III, 1845, *Cypraea*, pl xi, fig. 44.
Cypraea (*Aricia*) *caput-serpentis*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 129.
Erosaria caput-serpentis, Schilder, Proc Malac. Soc, XXIII, pt. iii, 1938, p 135.
Cypraea caput-serpentis, Gravely, Bull. Mad Govt Mus (Nat. Hist), V, No. 2, 1942, p 40 (foot-note).

This species is fairly common in the Pamban area, and both live specimens and empty shells have been collected. The shell is of moderate size, usually broadly ovate in outline, with a more or less strongly humped dorsum, and with a well marked callus thickening on either side, the dorsal aspect of which is marked off as a broad, dark brownish or even chestnut, unspotted margin, while the parts immediately above the anterior and posterior canals are marked by a much paler blotch, usually of a bright orange-brown colour. The large, oval, central area of the dorsal surface bounded by the unspotted margin is paler brown and marked with numerous, close-set, rounded, white spots. The teeth are well developed and the aperture is slightly dilated anteriorly. The basal surface is dark brown at the edges, but gets paler towards the aperture. The interestices between the teeth are white. In young shells the callus at the sides is not well developed and consequently the unspotted lateral margin is much reduced in proportion to the spotted area. Worn shells are readily distinguished by the presence of a broad, dark brown margin all round, bounding a clear, oval, white or more often pale violet space on the dorsal surface. Of the eight races into which Schilder splits this species, the Pamban specimens belong to race Ab, "*caput-serpentis.*" Living specimens are commonly found in crevices of stones on the reefs. 32 mm. Pamban, Krusadai and Shingle Islands.

Cypraea poraira Linné.

Plate IX, figs. *3a* and *3b*.

Cypraea poraria, Linné, Syst. Nat, Ed. XII, 1767, p 1180
Cypraea poraria, Reeve, Conch Icon, III, 1845, *Cypraea*, pl xviii, fig. 99.
Erosaria poraria, Schilder, Proc Malac. Soc, XXIII, pt. iii, 1938, p. 136.

This species is rare at Pamban and is represented in Mr. Crichton's collection by two shells from this locality. The shell is small, short and ovate with a slightly thickened margin

covered with callus at the sides ; the upper edge of this thickening on the side of the outer lip is marked by a series of indistinct, pit-like depressions, particularly towards the posterior end. The dorsal surface of the shell is brownish, marked with a number of small, rounded, white spots many of which are encircled by a dark brown, ring-like border. The callous sides and base of the shell are pale violet which fades almost into white towards the aperture. The teeth are small, close-set and produced partly across the base of the lips. Of the two races into which this species is split up, the Pamban specimens belong to race B, "*poraria.*" 16 mm. Pamban.

Cypraea erosa Linné.

Plate IX, fig. 4.

Cypraea erosa, Linné, Syst. Nat., Ed. X, 1758, p. 723, No. 315
Cypraea erosa, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl xi, fig. 43.
Cypraea (*Luponia*) *erosa*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 134.
Erosaria erosa, Schilder, Proc Malac. Soc., XXIII, pt. iii, 1938, p. 138.
Cypraea erosa, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No. 2, 1942, p. 40.

This species is not uncommon at Pamban ; live specimens and empty shells in both fresh and worn conditions have been collected. The shell is ovate in outline, with the lateral margins somewhat strongly thickened with callus and even appearing to be slightly reflected out. The upper edge of this reflected, thickened margin is often marked by a series of pits, these latter being more pronounced on the side of the outer lip. The dorsal surface is pale greenish brown, marked with numerous bluish white dots, and sometimes with indistinct brownish ones as well. The lateral margins bear a deposit of callus, and are whitish, often with a squarish brown spot in the middle. The teeth are strong and those of the outer lip are continued across the base and even extended up round the margin of the shell as strong ridges or crenulations. 27 mm. Pamban, Krusadai and Shingle Islands.

Cypraea ocellata Linné.

Plate IX, figs. 5*a* and 5*b*.

Cypraea ocellata, Linné, Syst. Nat., Ed. XII, 1767, p. 180.
Cypraea ocellata, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl. xv, fig. 73.
Erosaria ocellata, Schilder, Proc. Malac. Soc., XXIII, pt. iii, 1938, p. 138.
Cypraea ocellata, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 40.

This is another tolerably common species occuring at Krusadai, readily distinguished by its characteristic and beautiful pattern of colouration. The shell is roughly about the same size as that of *C. erosa*, but slightly more broadly ovate. The sides of the shell are thickened with callus and slightly reflected up, and the upper edge of the thickened margin is feebly pitted, especially on the side of the outer lip. The dorsal surface of the shell is pale pellowish brown or a bright orange-yellow, ornamented with numerous rounded white spots,

some of which have a well marked central reddish brown spot, resembling somewhat the pupil of an eye. The sides and base of the shell are covered with callus, and are whitish and faintly spotted with brown. The teeth are produced partly across the base of the lips. 26 mm. Pamban and Krusadai Island.

(Genus **Monetaria** *Troschel, 1863*).

Cypraea annulus Linné.

Plate IX, fig. 6.

Cypraea annulus, Linné, Syst. Nat., Ed X, 1758, p 723, No. 314.
Cypraea annulus, Reeve, Conch. Icon , III, 1845, *Cypraea*, pl. xv, fig. 71.
Cypraea annulus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 130.
Monetaria annulus, Schilder, Proc. Malac. Soc., XXIII, pt. iii, 1938, p. 141.

The genus *Monetaria* to which this species strictly belongs, has been split up by Schilder into two sub-genera, *Ornamentaria* and *Monetaria s. str.*, of which the present species is assigned to the former, characterized by the bluish grey colour of the dorsal area.

This species appears to be rather uncommon at Pamban, being represented in the Museum collection only by a single shell from Pamban collected by Mr. Crichton. The shell is small with a slightly humped dorsum, a concavely depressed base and a more or less evenly rounded, ovate profile. The sides are thickened, whitish and bear a deposit of callus, but they merge imperceptibly into the central portion of the dorsum which is of a pale bluish grey colour encircled by an oval, yellowish ring, which, however, is much faded in the shell represented in our collection. The columellar teeth are fine and close-set, while the labial ones are stronger and more markedly produced. Of the four races into which this species has been split up, the Pamban specimens will have to be assigned to "*annulus*". 15 mm. Krusadai Island.

Cypraea moneta Linné.

Plate IX, fig. 7.

Cypraea moneta, Linné, Syst. Nat , Ed. X, 1758, p 723, No. 312
Cypraea moneta, Reeve, Conch Icon , III, 1845, *Cypraea*, pl. xv, fig. 74.
Cypraea moneta, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 129.
Monetaria moneta, Schilder, Proc. Malac Soc , XXIII, pt iii, 1938, p. 142.
Cypraea moneta, Gravely, Bull. Mad. Govt Mus (Nat. Hist.), V, No. 2, 1942, p. 40.

This species is much commoner than the preceding one and both dry shells and live specimens have been collected in the Pamban area, the latter being often found under dead coral stones and shingle on the reefs in company with *C. arabica* and *C. errones*. The shell is readily distinguished from all others of the genus reported in this account, by the more or less marked angulation of the lateral margins rendering the shell somewhat rhomboidal in

outline. The sides are much thickened and form a broad, well defined and rather compressed marginal area which bears one or two obscure nodular swellings posteriorly and is often demarcated from the more strongly raised and humped central region of the dorsum by a depression, which, however, is often well marked only in front and behind. The teeth are strong and close-set, but not much produced. The dorsal surface is generally bright yellowish, but the margin is often paler or even whitish ; the hump of the dorsum is sometimes encircled by an oval, orange, ring-like line. 23 mm. Rameswaram, Pamban, Krusadai and Shingle Islands.

(Genus **Erronea** Troschel, 1863).

Cypraea pallida Gray.

Plate IX, fig. 8.

Cypraea pallida, Gray, Zoological Journal, I, 1824, p. 387.
Cypraea pallida, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl. xiii, fig. 54.
Erronea pallida, Schilder, Proc. Malac. Soc., XXIII, pt iii, 1938, p. 147.
Cypraea pallida, Gravely, Bull Mad. Govt. Mus. (Nat Hist), V, No. 2, 1942, p. 41

This species is represented in the collection by a young dead shell and two spirit-preserved specimens, and is much less common than the preceding species. The shell is broadly ovate in outline, and more or less pear-shaped. It may be readily distinguished from *C. errones*, which it tends to resemble in colouration, by the shell being broader, shorter and more elevated and by the labial teeth of the shell being more numerous and close-set. The dorsal surface is pale greenish grey, very minutely freckled with pale brownish markings throughout, but the centre is usually heavily mottled with dark brown. The sides are paler, almost whitish and spotted with brown, while the base is uniformly white. In the young shell there are two broad pale transverse bands across the dorsum and the aperture is dilated anteriorly. The teeth are short, numerous and close-set. 25 mm. Pamban.

Cypraea onyx Linné.

Plate IX, figs. 9*a* and 9*b*.

Cypraea onyx, Linné, Syst. Nat., Ed XII, 1791, p. 1177
Cypraea onyx, Reeve, Conch Icon , III, 1845, *Cypraea*, pl. x, fig. 39.
Erronea onyx, Schilder, Proc. Malac Soc., XXIII, pt. iii, 1938, p. 149.
Cypraea onyx, Gravely, Bull Mad. Govt. Mus (Nat Hist), V, No 2, 1942, p. 40.

This species is equally uncommon in the Pamban area, and is represented in the collection by two empty shells and two spirit-preserved specimens with the soft parts intact, both the varieties *a* and *b* figured by Reeve being represented among them. The shell is moderately large, thick, pear-shaped and bears an exquisitely fine gloss on the surface. It is dark chestnut-brown throughout, with two narrow, faint, paler brown bands across the back, rather widely separated ; the sides and base are deeper chestnut, while the teeth are bright

orange-yellow. The teeth are confined to the apertural margin, and the aperture is dilated anteriorly. Three out of the four shells in the collection belong to this variety. The second variety, differing from the first only in its colouration, is represented by a single dead shell ; in this, the dorsal surface of the shell is pale brownish, with two whitish, widely separated transverse bands, while the sides, base and extremities are of a much darker brown colour. The prolongation of the outer lip beyond the level of the columella lip posteriorly, is very well marked in this species. 41 mm. Pamban and Rameswaram.

There is also a small, thin, dark brown shell from Krusadai Island, with wide aperture and exposed spire, which has been identified by Mr. Winckworth as a young specimen of this species.

Cypraea errones Linné

Plate IX, figs. 10*a* and 10*b*.

Cypraea errones, Linné, Syst Nat., Ed X, 1758, p 723, No. 311
Cypraea errones, Reeve, Conch Icon, III, 1845, *Cypraea*, pl xiii, fig 56.
Cypraea errones, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 132.
Erronea errones, Schilder, Proc. Malac Soc, XXIII, pt iii, 1938, p. 152

Next to *C. arabica*, this species appears to be the commonest at Krusadai, and numerous specimens, both dead and living, have been collected from the reefs. The shell is rather narrow and elongately ovate with the extremities somewhat gradually narrowed. The posterior extremity is slightly produced owing to the greater prolongation of the outer lip at this end. The dorsal surface is pale greenish blue, minutely freckled with brownish markings. In the centre of the dorsum there is usually an irregular brownish blotch, but this may often be much disintegrated and even absent. The sides and base are uniformly yellowish white. The teeth are short and do not extend across the base of the shell. Of the four geographical races into which Schilder has split up this species, the Pamban forms belong to the race "*bimaculata*," distinguished by the aperture being narrow behind and much dilated in front. 27 mm. Pamban, Krusadai and Shingle Islands.

Cypraea caurica Linné.

Cypraea caurica, Linné, Syst Nat., Ed X, 1758, p 723, No. 313.
Cypraea caurica, Reeve, Conch Icon, III, 1845, *Cypraea*, pl xi, fig. 46.
Cypraea caurica, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 128.
Erronea caurica, Schilder, Proc. Malac. Soc, XXIII, pt. iii, 1938, p 153.
Cypraea caurica, Gravely, Bull Mad Govt Mus (Nat. Hist), V. No 2, 1942, p 41.

This species is represented in the collection by a dead shell and two spirit-preserved specimens with the soft parts intact, but it is by no means common at Krusadai. The shell is larger than that of *C. errones*, and usually elongate, cylindrically ovate, with a somewhat depressed dorsum. The sides are strongly thickened with callus deposit, the right side

being particularly strongly marginated. The dorsal surface is whitish, very closely and irregularly freckled with brownish markings of which those at the centre are usually darker and coalesce to form a more or less diffuse and irregularly broken blotch. The sides which bear a well marked callus deposit are whitish, marked with large, clouded, dark brown spots; the base is pale orange or flesh-coloured. The aperture is narrow behind, but dilated in front. The labial teeth are very stout and produced strongly across the base of the lip; the columellar teeth are thinner, narrower, more close-set and much produced, their outer ends being dilated. The Pamban specimens belong to the race "*corrosa*," distinguished from the other eastern races chiefly by the greater thickening of the right margin and by the columellar teeth being produced and dilated externally. 36 mm. Pamban and Shingle Island.

(Genus **Palmadusta** Iredale, 1930).

Cypraea asellus Linné.

Plate IX, fig. 11.

Cypraea asellus, Linné, Syst. Nat, Ed. X, 1758, p. 722, No. 309.
Cypraea asellus, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl. xviii, fig. 98.
Cypraea asellus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 134.
Palmadusta asellus, Schilder, Proc Malac. Soc., XXIII, pt. iii, 1938, p. 156.

The shell is small, and readily distinguished from those of the other Pamban species of *Cypraea* by the presence of three well marked, broad, transverse colour bands across the back; it is elongate with an ovate outline and a fairly elevated dorsum. The outer lip is produced posteriorly a little distance beyond the hind top of the inner lip. There is a thin layer of callus deposit at the sides, which forms a more or less definite margin especially on the right side The dorsal surface is whitish, traversed by three, very conspicuous, broad, dark-brown transverse bands which constitute the most distinctive feature of this species; these bands, however, may sometimes be much paler; they are crossed by fine, whitish, longitudinal lines of growth. The teeth bounding the aperture are rather fine and close-set. The Pamban specimens belong to the race "*asellus*" characterized by the posterior columellar teeth being rather produced and tuberculate. The two specimens in the Museum collection measure only 12 mm. in length, but a single shell in Mr. Crichton's collection is as much as 21 mm. long. Pamban.

Cypraea lentiginosa Gray.

Cypraea lentiginosa, Gray, Zoological Journal, I, 1825, p. 489, pl. 7 and 12, fig. 1.
Cypraea lentiginosa, Reeve, Conch Icon., III, 1845, *Cypraea*, pl. xii, fig. 49.
Palmadusta lentiginosa, Schilder, Proc. Malac. Soc., XXIII, pt. iii, 1938, p. 160.

This species is somewhat restricted in distribution, and is rare at Pamban, being represented in the collection only by a single, slightly worn, dead shell from that locality. The

shell is moderate-sized, more or less pear-shaped, with slightly produced extremities and elevated dorsum. The sides are slightly thickened with callus deposit. The dorsal surface is whitish, obscurely banded with three transverse rows of brownish, zig-zag markings and irregularly mottled with brown all over. The extremities of the dorsal surface are dark brown, while the sides and base are whitish, marked with distinct dark brown spots. The teeth on the lips are large, strong, rather widely set and strongly produced across the base of the outer lip and the columella. 30 mm. Pamban.

Cypraea gracilis Gaskoin.

Cypraea gracilis, Gaskoin, Proc. Zool Soc. London, 1848, p. 93
Palmadusta gracilis, Schilder, Proc Malac Soc., XXIII, pt. iii, 1938, p. 161.

This species is represented in the collection by a single spirit-preserved specimen. The shell is small, elongately ovate in profile and gradually narrowed towards the anterior extremity. The dorsal surface is pale bluish grey profusely marked all over with minute pale brown specks which appear as rounded dots under the lens. The centre of the dorsum is marked by a dark brown blotch more or less in the form of an incomplete transverse band. The sides and base are much paler than the dorsum, almost whitish and marked sparingly with distinct blackish brown spots ; the extremities are marked by a pair of large purplish brown spots which are conspicuous both dorsally and ventrally. The sides of the shell are not appreciably thickened, though the right side bears a definitely more conspicuous deposit of callus. The anterior columellar teeth are larger than the rest. The Pamban specimens belong to the race "*gracilis*," distinguished by the aperture being not dilated in front. 17 mm. Krusadai Island.

Cypraea fimbriata Gmelin.

Cypraea fimbriata, Gmelin, Syst Nat., Ed , XIII, 1791, p. 3423.
Cypraea fimbriata, Reeve, Conch Icon., III, 1845, *Cypraea*, pl. xviii, fig. 92.
Cypraea fimbriata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 127.
Palmadusta fimbriata, Schilder, Proc. Malac, Soc., XXIII, pt iii, 1938, p. 162.
Cypraea fimbriata, Gravely, Bull. Mad. Govt Mus. (Nat Hist.), V, No 2, 1942, p. 41.

This species is rare at Pamban and is represented by a single dead shell from that locality. The shell is small, elongately ovate in outline, with slightly thickened sides. The dorsal surface is whitish, freckled all over with pale greenish brown markings. There is a large indistinct brownish blotch in the centre of the dorsum. The extremities are marked by two large, conspicuous, brownish violet spots one on either side. The teeth are small, close-set and produced partially across the base of the outer and columellar lips. The aperture is markedly dilated anteriorly. The Pamban specimens are assigned to the race "*fimbriata*," characterized by the sub-convex base and rather constricted extremities. 17 mm. Pamban.

(Genus **Blasicura** Iredale, 1930).

Cypraea hirundo Linné.

Cypraea hirundo, Linné, Syst Nat., Ed. XII, 1767, p. 1178.
Cypraea hirundo, Reeve, Conch Icon., III, 1845, *Cypraea*, pl. xix, fig. 104.
Blasicura hirundo, Schilder, Proc. Malac. Soc., XXIII, pt. iii, 1938, p. 166.

Only two dead shells of this rather uncommon species are represented in the collection. The shell is elongately ovate, with the sides scarcely thickened, and the outer lip slightly produced posteriorly. The dorsal surface is pale greyish blue with two or more irregular whitish patches often in the form of widely separated, incomplete and broken transverse bands, and with a number of small brownish specks scattered all over the surface ; some of these fine brownish markings attain the form of moderate-sized blotches. The sides are whitish, distinctly spotted with dark brown. The extremities are marked by a pair of large, very dark purplish brown spots. The base is whitish, the teeth strong, rather widely set and partly produced. The Pamban forms belong to the race " *hirundo* " distinguished by the cylindrically ovate shape of the shell and the sides being rounded rather than angular 20 mm. Pamban.

(Genus **Luria** Jousseaume, 1884).

Cypraea isabella Linné.

Plate IX, fig. 12.

Cypraea isabella, Linné, Syst Nat, Ed. X, 1758, p. 722, No. 304.
Cypraea isabella, Reeve, Conch Icon, III, 1845, *Cypraea*, pl. xxi, fig. 51.
Cypraea isabella, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 126.
Luria isabella, Schilder, Proc. Malac. Soc, XXIII, pt. iii, 1938, p 176

This species is known to be widely distributed in the Indo-Pacific region, and Mr. Crichton's collection contains three fine shells from Pamban ; but the single shell contained in the original Museum collection is labelled " shell bazaar, Rameswaram " and is much smaller. The shell is readily distinguished from those of the other species recorded from Pamban, by its peculiar cylindrically ovoid shape, a somewhat depressed dorsum, and the following characteristic pattern of colouration : the dorsal surface is pale ashy brown (more rarely ashy green), very faintly marked with two or three whitish, broad transverse bands and beautifully ornamented with longitudinal rows of delicate, brownish or blackish dots and short, irregularly broken lines or dashes ; the extremities are bright orange-red, while the base and sides are uniformly white ; the surface is smooth and highly polished. The teeth are fine, numerous and close-set. The Pamban forms belong to the race " *rumphi*," distinguished from the allied " *isabella* " by the extremities being narrowed rather abruptly and by the callus deposit on the sides being less strongly marked. 20 mm. Pamban.

(Genus **Callistocypraea** Schilder, 1927).

Cypraea testudinaria Linné.

Plate IX, fig 13.

Cypraea testudinaria, Linné, Syst. Nat, Ed. XII, 1767, p 1173.
Cypraea testudinaria, Reeve, Conch Icon, III, 1845, *Cypraea*, pl. iii, fig 9
Callistocypraea testudinaria, Schilder, Proc. Malac Soc, XXIII, pt iii, 1938, p. 178.

This species is represented by two shells from Pamban in Mr. Crichton's collection, but it is by no means common in this area, and it is doubtful whether specimens occur in the littoral zone anywhere in the vicinity of Krusadai Island. The shell is very large, perhaps the largest of Pamban Cypraeid shells, and bears an exquisitely polished surface. It is much elongated in proportion to its width, more or less cylindrically ovoid, and rather abruptly narrowed towards the extremities ; the dorsum is more or less straight and evenly flattened about the middle in profile, instead of being convexly humped as in many other species. The colouration is somewhat elaborate, but very characteristic ; the dorsal surface and sides are pale whitish brown, profusely clouded with violet-brown and marked with large, rounded chestnut spots scattered all over and with a few irregular blotches of the same colour here and there ; in addition to this confused pattern, the surface is profusely stippled all over with very fine milk-white dots , the basal surface is pale fleshy brown. The teeth are small in proportion to the size of the shell, very numerous, uniformly close-set and confined to the apertural margins of the lips. The aperture is dilated in front. Of the three geographical races of this species, the Pamban forms belong to the race "*testudinaria*." 111 mm. Pamban.

(Genus **Talparia** Troschel, 1863).

Cypraea talpa Linné.

Plate X, fig 1.

Cypraea talpa, Linné, Syst. Nat, Ed X, 1758, p 720, No 292.
Cypraea talpa, Reeve, Conch Icon, III, 1845, *Cypraea*, pl ii, fig. 5.
Cypraea talpa, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 127.
Talparia talpa, Schilder, Proc Malac. Soc., XXIII, pt iii, 1938, p 180.

The present species is nearly as rare as the preceding one at Pamban, and only one worn and two moderately fresh dead shells are contained in the collection. The shell is fairly large, oblong-ovoid, but shorter in proportion to the width than in the preceding species, and with a more or less flattened base and slightly attenuated extremities. The outer lip is produced a little beyond the end of the columellar lip at the posterior extremity. The dorsal surface is pale creamy yellow, with three or four rather indistinct, broad, brownish transverse bands ; in marked contrast to this, the sides, base and extremities are of an intense blackish brown colour, but the interstices between the teeth are yellowish. The anterior columellar teeth are oblique and irregular. The Pamban forms belong to the race

"*talpa*," distinguished from the others by its more strongly flattened base and by the aperture being less markedly dilated in front. 72 mm. Pamban.

(Genus **Mauritia** Troschel, 1863).

Cypraea arabica Linné.

Plate X, figs. 2*a* and 2*b*.

Cypraea arabica, Linné, Syst Nat., Ed. X, 1758, p. 718, No. 286.
Cypraea arabica, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl. 1, fig. 2.
Cypraea arabica, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 129.
Mauritia arabica, Schilder, Proc. Malac Soc., XXIII, pt. iii, 1938, p. 183
Cypraea arabica, Gravely, Bull. Mad. Govt Mus. (Nat. Hist.), V, No. 2, 1942, p. 41.

This is the commonest species of *Cypraea* represented at Pamban. Large numbers of both live specimens and empty shells have been collected ; the majority of dead shells found washed up on the beach, however, are in a badly worn and bleached condition. The shell is moderately large, and readily distinguished by its oblong-ovate shape, flattened base, more or less pronounced callus thickening at the sides, and by its characteristic colouration : the dorsal surface is pale bluish grey, clouded with ill defined brownish blotches, and ornamented closely and profusely with longitudinal rows of dark brown, hieroglyphic markings ; the callous sides and base are feebly tinged with pale brown, the sides being also marked with clouded, dark purplish brown spots. The teeth are strong, orange-brown and produced partially across the base of the lips. The aperture is strongly dilated in front. The Pamban forms belong to the race "*dilacerata*" distinguished from the western races by the more acuminate extremities and the sharply marginated sides. Young specimens have a much thinner shell, with an exposed spire, a much wider aperture, two or three broad pale-coloured transverse bands and irregular brownish zig-zag markings.

In the variety *histrio*, which is also well represented at Pamban, and considered to be a distinct species by Schilder, the shell is thicker with a more elevated dorsum, while the dorsal markings are somewhat widely separated, forming a more open network with clear, circular lacunae of the ground colour representing its meshes.

The size of the adult shell of *Cypraea arabica* varies considerably, but on the average it is about 40 mm. long. Pamban, Krusadai and Shingle Islands.

(Genus **Cypraea** Linné, 1758).

Cypraea tigris Linné.

Plate X, fig. 3.

Cypraea tigris, Linné, Syst. Nat., Ed X, 1758, p. 721, No. 302.
Cypraea tigris, Reeve, Conch. Icon., III, 1845, *Cypraea*, pl iv, fig. 12.
Cypraea tigris, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 131.
Cypraea tigris, Schilder, Proc. Malac. Soc., XXIII, pt. iii, 1938, p. 185.
Cypraea tigris, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 40 (foot-note).

This species is represented in the gallery collection by a single large dead shell labelled " Pamban," but as in the case of *C. testudinaria*, it is not certain whether living specimens of this species occur in the littoral zone surrounding Krusadai Island. The shell is large, thick, pear-shaped, with a strongly elevated dorsum and a slightly concavely depressed basal surface ; the sides are evenly rounded off, and not much thickened with callus. The dorsum and sides are pale yellowish white, profusely ornamented with large, rounded blackish brown spots each of which is edged with a clouded ring of pale bluish grey. The base is pure white. The teeth are strong, the labial ones being especially stout. The aperture is dilated anteriorly, and the edge of the outer lip is slightly hollowed in front. The specimen referred to above is a particularly large one, measuring about 100 mm. in length, but adult shells of much smaller dimensions have been collected from the Indian waters and are represented in Mr. Crichton's collection. Pamban.

There is also a young Pamban specimen of this species in the collection, measuring 56 mm. in length. As usual, the shell is thin with wide aperture, exposed spire and thin outer lip ; it is obscurely banded with rows of violet-brown patches and marked with rounded, horny brown spots.

Large shells of this species are frequently used as ornamental paper weights on account of their fine gloss and considerable weight.

(Sub-genus **Lyncina** Troschel, 1863).

Cypraea lynx Linné.

Plate X, fig. 4.

Cypraea lynx, Linné, Syst. Nat, Ed X, 1758, p. 721, No 303.
Cypraea lynx, Reeve, Conch Icon., III, 1845, *Cypraea*, pl ix, fig. 33
Cypraea lynx, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 131.
Cypraea (Lyncina) lynx, Schilder, Proc Malac Soc, XXIII, pt iii 1938, p. 186.

This species is represented in the Museum collection by two dead shells from Pamban, but Mr. Crichton's collection contains a number of shells from Ceylon, Laccadive and Fiji Islands. The shell is moderately large, somewhat elongately ovoid, with an elevated dorsum and slightly acuminated extremities. The dorsal surface is whitish, mottled with brownish and pale bluish markings, rather sparingly spotted with large, rounded blackish brown spots at wide and irregular intervals The sides are white, thickened with callus, and marked with indistinct, clouded, brownish spots. The base is flattened and uniformly whitish. The teeth are strong and whitish, while the interstices between them are of a deep, orange-red colour. 46 mm. Pamban.

Cypraea carneola Linné.

Plate X, fig. 5.

Cypraea carneola, Linné, Syst Nat., Ed X, 1758, p. 719, No. 290.
Cypraea carneola, Reeve, Conch Icon., III, 1845, *Cypraea*, pl IV, fig. 19.
Cypraea carneloa, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 126.
Cypraea (Lyncina) carneola, Schilder, Proc Malac. Soc., XXIII, pt. III, 1938, p. 186.

This species is as rare at Pamban as the preceding one, and only two dead shells are contained in the collection. The shell is oblong-ovate, with more or less blunt extremities, and looks somewhat like a barrel in a view from above. The dorsal surface is pale cream-coloured, marked with four or five broad, pale fleshy pink, transverse bands. The sides are slightly thickened with callus and finely mottled with sandy grey. The base is uniformly pale yellowish, while the teeth and interstices are of a bright violet colour. The aperture is slightly, but gradually widened towards the anterior extremity. The teeth are strong, numerous, close-set and are not produced across the bases of the columellar and outer lip. The Pamban forms belong to the race "*carneola*," distinguished from the western races by the presence on the dorsum of a pale oval ring of the ground colour separating the banded central area from the mottled lateral regions. 38 mm. Pamban.

A study of the geographical distribution of the species of *Cypraea* reveals the fact that it is quite possible that many other species such as *C. felina*, *C. producta*, *C. scurra*, *C. vitellus*, *C. mauritiana* should also occur in the Pamban area, though no specimens have yet been collected from the immediate vicinity of this locality. It is therefore very likely that the above list will be amplified by keen and intensive efforts on the part of future collectors.

Genus **Ovulum** Bruguière, 1792.

(Syn. **Amphiperas** Gronovius, 1781).

The shell is moderate-sized, ovate or more or less elongately spindle-shaped ; the extremities are often produced and canaliculated. The surface is either smooth or finely striated ; the aperture is long and narrow and the columella is smooth.

Three species are recorded from Pamban ; they may be distinguished as follows :—

1. Shell large with inflated body whorl ; anterior and posterior canals greatly elongated into long, slender, slightly curved, spout-like projections ; aperture fairly wide ... ... *O. volva*.

— Shell much smaller ; body whorl considerably less inflated and proportionately more elongate ; anterior and posterior canals much less elongate, not

slender and abruptly narrowed, but more or less gradually tapering from the body of the shell; aperture much narrower 2

2. Shell not very small, reaching a length of more than 2½ cm.; elongately ovate; anterior and posterior canals moderately elongate, tapering to more or less sharply pointed extremities; middle portion of body whorl not angularly swollen; *surface of thickened outer lip smooth* .. .. *O. birostre.*

—Shell very small, hardly exceeding a length of 9 mm.; canals not appreciably produced and extremities consequently more or less obtuse; middle portion of body whorl rather angularly inflated; surface of thickened outer lip conspicuously transversely toothed ... ... *O. formosum.*

Ovulum formosum Adams and Reeve.

Plate X, figs. 6*a* and 6*b*.

Ovulum formosum, Adams and Reeve, Zoology of the "Samarang", 1850, Mollusca, p. 22, pl. vi, fig. 6.
Ovulum formosum, Reeve, Conch. Icon., XV, 1866, *Ovulum*, pl viii, fig 39.
Ovulum formosum, Tryon, Man Conch., VII, 1891, p 251, pl. iv, figs 15 and 16
Amphiperas (Cyphoma) formosum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 143.

This is the commonest species of *Ovulum* recorded from Pamban, and is represented in the collection by four dead shells. The shell is small, about 8 to 9 mm. in length, more or less elongately rhomboid, being angularly swollen about the middle and narrowed towards the extremities The surface of the shell is traversed by regular, uniformly close-set, spiral striae, which, when examined with a lens, are seen to be finely pitted. The aperture is in the form of a narrow, elongated slit, and the inner surface of the thickened outer lip is strongly denticulated. The shell is of a fine, bright purplish pink or violet-brown colour; the extremities are paler, usually light brownish yellow. Pamban.

Ovulum birostre (Linné).

Plate X, figs. 7*a* and 7*b*.

Bulla birostris, Linné, Syst Nat, Ed. XII, 1767, p 1182.
Ovulum birostre, Reeve, Conch. Icon., XV, 1866, *Ovulum*, pl x, fig 45.
Ovulum birostre, Tryon, Man Conch., VII, 1891, p 253, pl. iv, figs. 10 and 11.
Amphiperas (Radius) birostre, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 145.

The shell is much larger than in the preceding species, elongately ovate, more or less spindle-shaped, with an elongated body whorl and moderately produced anterior and posterior

canals which taper gradually from the body whorl to more or less sharply pointed extremities; the middle portion of the body whorl is evenly rounded, unlike the previous species. The edge of the outer lip forms a stout, ridge-like thickening, the surface of which is smooth. The aperture is narrow above, but a little wider below, where the outer lip is sinuate. The shell is pale fleshy pink, and the extremities are paler, almost whitish. Pamban.

Ovulum volva (Linné).

Plate X, fig. 8.

Bulla volva, Linné, Syst Nat, Ed XII, 1767, p. 1182.
Ovulum volva, Adams and Reeve, Zoology of the "Samarang", 1850, Mollusca, p. 19, pl. vi, fig. 9,
Ovulum volva, Reeve, Conch. Icon, XV, 1866, *Ovulum*, pl. ix, fig. 41.
Ovulum volva, Tryon, Man. Conch., VII, 1891, p. 252, pl. iv, figs 94 and 95.
Amphiperas (*Radius*) *volva*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 143

This species, said to be widely distributed in the Eastern seas, is represented in the collection by a single, rather worn, empty shell from Pamban. The shell, popularly known as the "Weaver's shuttle", is somewhat large, measuring over three inches in length. The body of the shell is elongately ovate and inflated, while the anterior and posterior canals are greatly elongated to form long, slender, slightly curved, spout-like projections at each end. The aperture is fairly wide, and the outer lip is thickened in the adult. As the present specimen is worn, it has lost its colour, and is nearly white throughout; but the colour of the shell, when fresh, is said to be bright pinkish; a fine, living specimen of this species is figured by Adams and Reeve in their work cited above. Pamban.

SERIES DOLIACEA.

Family CASSIDIDAE.

The shell is of variable size, usually thick, with short, conical, or almost flattened spire and large, generally inflated body whorl, and either smooth or sculptured. The aperture is usually long and narrow and the outer lip often very much thickened and strongly toothed within; the columella is generally provided with a wrinkled callus. The operculum is horny and marginally nucleated This family includes the helmet shells.

Five species of the genus *Phalium* are recorded from Pamban.

Genus **Phalium** Link, 1807.

The shell bears a conical spire and moderately elongated aperture which is often angular above and gradually widened below; the anterior canal is short and deeply excavated. The outer lip is moderately thickened and more or less reflected, while the columellar callus is ridged.

The Pamban species of *Phalium* may be distinguished as follows :—

1. Shell large, body whorl boldly elevated on the side away from the apertural surface, and rather angularly shouldered towards the spire 2

—Shell smaller, body whorl less strongly elevated on the side away from the apertural surface, and evenly rounded above, without angular shoulder towards the spire 3

2. Angular shoulders on whorls provided with a row of sharply pointed tubercles ; shell usually uniformly pale ashy blue, without definite colour patches ... *P. glaucum.*

—Angular shoulders on whorls smooth and much blunter, without tubercles or nodules ; shell marked with a bold pattern of numerous large, squarish, brown patches arranged in regular spiral rows on a white ground .. .. *P. areola.*

3. Surface of shell traversed by regular, evenly spaced spiral grooves, and inner margin of thickened outer lip of aperture more or less strongly toothed ; aperture relatively broad ; ridges on the columellar lip towards the posterior end of aperture conspicuous ... 4

—Surface of shell not grooved as above ; aperture narrower and proportionately more elongate ; basal surface of thickened outer lip beset with a few, widely-set, sharply pointed tubercles ; ridges on hind part of columellar lip inconspicuous .. .. *P. ponderosum.*

4. Spiral grooves on surface of shell strong and somewhat widely spaced ; sutures sunk in deep grooves ; teeth on the inner margin of the outer lip of aperture stronger and less widely separated ... ... *P. canaliculatum.*

—Spiral grooves on surface of shell weaker, more numerous and more close-set ; sutures normal, not sunk in grooves ; teeth on the inner margin of outer lip of aperture weaker, but more widely separated ... *P. bisulcatum.*

Phalium areola (Lamarck).

Plate XI, fig 1.

Cassis areola, Lamarck, Anim. sans vert, (Deshayes' edit.), X, 1845, p. 27.
Cassis areola, Reeve, Conch. Icon., V, 1849, *Cassis*, pl. IX, fig 24
Phalium areola, Bayer, Catalogue Cassididae, Zool. Mededeel., XVIII, 1935, p. 98.
Phalium areola, Crichton, Journ. Bomb. Nat Hist. Soc., XLII, 1941, p. 332.
Phalium areola, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, pp. 42 and 43.

The shell is moderately large, with a sharply pointed spire, the whorls of which are finely reticulately sculptured ; the longitudinal ridges, however, are stronger than the spiral ones, and the sculpture, as a whole, becomes much weaker on the lower whorls of the spire. The body whorl is smooth and glossy, whitish, marked with four or five regular spiral rows of large, squarish, or rather D-shaped brownish patches which are continued even on to the widely expanded columellar lip. Well developed varices are present, one to each whorl. The body whorl bears a smooth, bluntly angular shoulder towards the spire. The outer lip is strongly reflected and its inner surface bears strong, widely set teeth. The anterior part of the columella is obliquely plicated. The anterior canal is deep and deflected to the left. Pamban.

Phalium glaucum (Linné).

Plate XI, fig 2.

Cassis glauca, Linné, Syst. Nat, Ed. X, 1758, p 737, No 391.
Cassis glauca, Reeve, Conch Icon, V, 1849, *Cassis*, pl XII, fig 33.
Cassis glauca, Tryon, Man. Conch., VII, 1891, p. 276, pl. VI, figs 79 and 80
Cassis (Bazoardica) glauca, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 122.
Phalium glaucum, Bayer, Catalogue Cassididae, Zool Mededeel., XVIII, 1935, p 99
Phalium glaucum, Crichton, Journ. Bomb. Nat. Hist. Soc, XLII, 1941, p 332.
Phalium glaucum, Gravely, Bull. Mad Govt Mus (Nat Hist.), V, No 2, 1942, pp. 42 and 43.

This species is reported to be common in the Indian waters, but is represented in the collection by only a single empty shell from Pamban, where, as a rule, it is much rarer than at Madras. The shell is large with a strongly inflated body whorl and a short, conical spire ; the body whorl is smooth and glossy in the adult, but spirally striated when young ; there are, however, a few faint spiral grooves at the base of the body whorl persistent even in the adult. The upper whorls of the spire are finely reticulately sculptured. The whorls bear strong, sharply angualr shoulders, the one on the body whorl being very near the suture, while those on the spire lie at about the middle of the whorls ; they are beset with a row of sharply pointed tubercles. The columellar lip is broadly expanded, and its lower part strongly wrinkled. The inner margin of the thickenend outer lip is strongly denticulated. The shell is pale bluish grey, tinged with pale orange brown on the lips, while the interior of the aperture is dark brown. Pamban.

Phalium canaliculatum (Bruguière).

Plate XI, fig 3.

Cassidea canaliculata, Bruguière, Encyclopédie, Méthodique, Vers, 1792, p. 423.
Cassis canaliculata, Lamarck, Anim. sans vert, (Deshayes' edit), X, 1845, p 37.
Cassis canaliculata, Reeve, Conch. Icon, V, 1849, *Cassis*, pl. iii, fig. 8.
Cassis canaliculata, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 123.
Phalium canaliculatum, Bayer, Catalogue Cassididae, Zool. Mededeel, XVIII, 1935, p. 101.
Phalium canaliculatum, Gravely, Bull. Mad. Govt. Mus. (Nat Hist), V. No. 2, 1942, pp. 42 and 43.

The shell of this species is readily distinguished from those of the remaining Pamban ones by the sutures being markedly sunk in deep, broadly excavated grooves, somewhat as in *Babylonia spirata*. The surface is uniformly traversed by strong, regular, moderately widely spaced spiral grooves. The lower part of the columellar lip is strongly but irregularly plicated, and its upper end bears a few transverse ridges. The inside of the thickened outer lip is strongly transversely toothed. The whorls are evenly rounded and not angulated as in the two preceding species. The aperture is very broad below, but angularly narrowed posteriorly. The colour of the single Pamban shell of this species in the collection is rather faded, and almost white throughout, but traces of the spiral rows of oval, yellowish brown spots, characteristic of this species, can still be made out on the surface. Pamban.

Phalium bisulcatum (Schubert and Wagner).

Plate XI, fig. 4.

Cassis bisulcata, Schubert and Wagner, Fortsatz, Martini-Chemn., Conch. Cab., XII, 1829, p. 68, pl 223.
Cassis bisulcata, Reeve, Conch Icon, V, 1849, *Cassis*, pl iii, fig 6.
Cassis saburon var. bisulcata, Tryon, Man Conch, VII, 1891, p 276, pl. v, fig. 78.
Cassis (Semicassis) bisulcata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 122.
Phalium bisulcatum, Bayer, Catalogue Cassididae, Zool. Mededeel., XVIII, 1935, p. 101.
Phalium bisulcatum, Gravely, Bull Mad. Govt. Mus. (Nat. Hist), V, No. 2, 1942, pp 42 and 43

The shell closely resembles that of the preceding species but may at once be distinguished from it by the characters enumerated in the key given above ; it is moderately small, with a short, depressly conical spire, the whorls of which are scarcely inflated. The surface is spirally grooved throughout, but the grooves are distinctly weaker, more numerous and close-set than in the preceding species. The characters of the outer lip, columella and aperture are more or less the same as in that species, but the teeth on the inside of the outer lip are weaker and more widely spaced. The single shell in the collection is rather worn and has lost most of its original colouration, but faint remnants of squarish yellow spots characteristic of the species are still seen on portions of the surface. Shingle Island.

Phalium ponderosum (Gmelin).

Plate XI, fig. 5.

Buccinum ponderosum, Gmelin, Syst. Nat, Ed. XIII, 1791, p. 3477.
Buccinum nodulosum, Gmelin, Syst. Nat, Ed XIII, 1791, p 3479.
Cassis torquata var. B, Reeve Conch. Icon., V, 1849, *Cassis*, pl. i, fig. 1c.
Phalium ponderosum, Bayer, Catalogue Cassididae, Zool. Mededeel., XVIII, 1935, p. 113.

This species is represented in the collection by a single, rather badly worn shell from which most of the original colour markings have disappeared. The shell is moderately small, elongately ovoid, with a considerably raised spire and sharply pointed apex. The whorls are devoid of varices, and the surface is quite smooth without spiral ribs or grooves ; and in the present specimen, even the row of blunt nodules at the upper part of the body whorl, charateristic of the species is almost completely worn away ; the walls of the wholrs are moderately convex and evenly rounded. The aperture is somewhat narrow and strongly angular above. The columellar border is not appreciably thickened with callus and is angular about the middle, the part of the surface below this angle being strongly transversely wrinkled, and towards the base there is one particularly strong fold. The lower surface of the thickened and reflected outer lip bears about seven, rather widely spaced, short, pointed tubercles, while the inner margin of the outer lip bears as usual numerous transverse teeth. The shell is pale yellowish white, with spiral rows of brownish spots on the upper and lower parts, but only very faint remnants of these markings are seen in the shell examined ; but it still retains a longitudinal row of orange-brown spots on the outer surface of the thickened, ridge-like margin of the outer lip. Krusadai Island.

Family CYMATIIDAE.

This family includes the shells commonly known as Tritons. The shell is thick and solid, with well elevated spire, and almost always with well developed varices and strong tuberculated or ridged sculpture. The shell is covered with a distinct, horny periostracum when fresh. An anterior canal is present, but the posterior canal is absent. The columella bears a callus deposit ; the outer lip is thickened and the operculum horny.

Two genera, *Gyrineum* and *Cymatium*, are represented at Pamban ; in the former the shell is ornamented throughout with regular, spiral rows of rounded tubercles, while in the latter the sculpture is more varied, consisting usually of coarse spiral ridges and sometimes a row of large nodule-like swellings on the angular shoulders of the whorls.

Genus **Gyrineum** Link, 1807.

Thiele includes this as a sub-genus under the genus *Argobuccinum* Bruguière, 1792. It is characterized by the shell being usually small, the varices being rounded and compressed, and the sculpture being granular.

A single species, *G. natator*, has been recorded.

Gyrineum natator (Röding).

Plate XI, fig. 6.

Tritonium natator, Roding, Mus. Bolten, 1798, 127
Ranella tuberculata, Broderip, Proc. Zool. Soc. London, 1842, p. 179.
Ranella tuberculata Reeve, Conch. Icon , II, 1844, *Ranella*, pl vii, fig. 36
Ranella tuberculata, Watson, " Challenger ", Zoology, XV, 1886, Gastropoda, p. 396.
Gyrineum natator, Crichton, Journ. Bomb. Nat. Hist Soc., XLII, 1941, p. 336.
Gyrineum natator, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No. 2,1942, p. 43.

This species, living specimens of which are reported to be abundant in the Madras harbour, is almost equally well represented at Pamban, where a large number of live specimens may be found attached to boulders under the Pamban ridge. The shell is thick, coarse-looking, with an elevated, conical spire, somewhat compressed whorls, and ornamented all over with regular spiral rows of close-set, rounded tubercles ; the interstices between the rows of tubercles bear a finely latticed sculpture. Each whorl is provided with a pair of varices, one on each side, those of successive whorls forming a continuous, crest-like ridge from the apex to the basal end of the body whorl ; they are strongly transversely ridged ; the lips of the aperture are lined inside with a thin layer of polished white callus, and the inside of the outer lip bears a few widely spaced ridge-like teeth ; the columella is traversed by a few feebly developed oblique folds at the upper part. The shell is of a dull greyish brown colour throughout. Pamban.

Genus **Cymatium** (Bolten) Röding, 1798.

The shell is ornamented with simple or nodular spiral ridges ; the aperture is narrowly ovate and provided with an anterior canal which may either be short or elongated. The operculum is excentrically nucleated.

Three species have been recorded ; they may be distinguished as follows :—

1. Shell comparatively thin, more or less uniformly traversed throughout with regular, simple, somewhat flattened spiral ridges ; basal tapering portion of the body whorl rather strongly curved away from the aperture ; varices absent or rudimentary ; callus on columella feebly developed and smooth ; inside of outer lip smooth ... ... *C. cingulatum.*

—Shell much thicker, spiral ridges when present usually granular, or more irregularly developed and disposed ; varices strongly developed and in addition to these, transpiral ridges generally present ; basal portion of

the body whorl less markedly curved away from the aperture ; callus on columella thick and usually strongly wrinkled ; inside of outer lip distinctly toothed 2

2. Shell somewhat elongate and spindle-shaped, with strong granular spiral ridges which are alternately double and single. Whorls not conspicuously angular ; varices well developed, but additional transpiral rigdes between the varices rudimentary or absent ; wrinkles on columella strong ... ... *C. pileare.*

— Shell much thicker, broader and more massive ; spiral ridges reduced or ill developed, but shell ornamented with strong additional transpiral ridges between the varices, represented particularly by enormously developed, angular tuberculated projections ; whorls strongly angularly shouldered ; wrinkles on columella weak or obsolete ... ... *C. rhinoceros.*

Cymatium pileare (Linné).

Plate XI, figs. 7*a* and 7*b*.

Murex pilearis, Linné, Syst. Nat., Ed X, 1758, p 749, No 458
Triton pilearis, Lamarck, Anim. sans vert., (Deshayes' edit), IX, 1843, p. 630.
Triton pilearis, Reeve, Conch Icon , II, 1844, *Triton*, pl vii, fig. 23
Aquillus (*Lampusia*) *pilearis*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 110.
Cymatium pileare, Thiele, Handbuch der systematischen Weichtierkunde, II, 1932, p. 282.
Cymatium pileare, Gravely, Bull. Mad. Govt Mus. (Nat Hist), V, No. 2, 1942 p. 44.

Two dead shells from Pamban are contained in the collection. The shell is somewhat elongate and spindle-shaped, with the spire strongly elevated and the body whorl tapering below. The whorls are closely and strongly spirally ribbed ; the ribs present a finely beaded appearance and alternate ribs are stouter and rendered double by a median spiral groove dividing each of them partially. There are about seven varices, but only two (one on either side of the aperture) are strongly developed, the rest being scarcely raised. The aperture is narrow, ovate with a moderately produced anterior canal. The columella and the inner surface of the outer lip are traversed by very strong, whitish, wrinkle-like ridges, those on the outer lip occurring in pairs. The shell is covered with a hairy periostracum when fresh ; the surface is pale yellowish, heavily streaked with brown here and there, while the interior of the aperture is deep orange-brown. Pamban.

Cymatium rhinoceros (Lamarck).

Plate XII, fig. 1.

Triton lotorium, Lamarck, Anim. sans vert., (Deshayes' edit), IX, 1843, p 631
Triton lotorium, Reeve, Conch Icon , II, 1844, *Triton*, pl. vi, fig 19.
Cymatium rhinoceros, Gravely, Bull Mad. Govt Mus (Nat. Hist), V, No. 2, 1942, p. 44.

This species is reported to be common in Ceylon, but rare in the Pamban area, being represented in the collection by a single very badly worn and corroded shell which was found washed up on the beach on Shingle Island. The shell is large and thick, with the body whorl broadly expanded above and rather abruptly narrowed below, and with a moderately elevated, turretted spire. The varices are very thick and raised, the two principal ones on the body whorl being particularly strong, and traversed by deep transverse depressions, which in their turn are strongly transversely grooved. The whorls are strongly and angularly shouldered at the upper part, and the additional transpiral ribs between the varices stand out as strong, angular projections, which are most prominent and raised at this shouldered part of the whorls. The anterior canal is fairly elongate. The original colour of the specimen is almost entirely lost, but traces of the dark brown transverse bands on the varices are still seen. Shingle Island.

Cymatium cingulatum (Lamarck).

Plate XII, figs. 2*a* and 2*b*.

Cassidaria cingulata, Lamarck, Anim. sans vert , (Deshayes' edit), X, 1845, p. 9.
Triton cingulatus, Reeve, Conch Icon., II, 1844, *Triton*, pl. xi, fig. 35.
Cyamatium cingulatum, Gravely, Bull. Mad Govt. Mus (Nat Hist.), V, No. 2, 1942, p. 43.

This species is represented by two young shells from Pamban. The shell is much thinner than in either of the two preceding species, and the edge of the outer lip is thin. The spire is moderately elevated and conical, and in both the shells examined, the protoconch is persistent at the apex as a small, smooth, shining, spiral structure. The surface is uniformly ornamented with regular, flattened, evenly spaced, spiral ridges. The whorls are very feebly angulated above. The anterior canal is moderatley produced and rather strongly twisted. The aperture is wider than in either of the two preceding species. The outer surface of the shell is more or less uniformly pale brown throughout, while the interior of the aperture is white ; in young shells, the inside of the outer lip is not toothed, and the columellar callus is very thin and practically smooth. Pamban.

Family BURSIDAE.

The shell is usually moderately large and thick, with elevated spire and more or less strong scuplture ; the whorls are provided with diametrically opposed varices. The shell on the whole resembles closely that of the preceding familiy, but differs from it in the presence of a posterior canal (which, however, may be absent in very young shells).

This family includes a single genus, *Bursa*.

Genus **Bursa** (Bolten) Röding, 1798.

With the characters of the family.

The Pamban species of *Bursa* may be distinguished as follows :—

1. Shell very coarse-looking, ornamented with a few, large, irregular, widely spaced tubercles ; varices on the several whorls disposed on different radii, and hence not forming continuous ridges ... ... *B. rubeta.*

— Surface of shell less coarse-looking ; varices two to each whorl and disposed in such a manner as to form two continuous ridges, one on either side, extending right from the base of the body whorl to the apex of the shell 2

2. Shell uniformly ornamented with numerous, regular, close-set spiral rows of small, rounded tubercles as in *Gyrineum natator* ; whorls evenly rounded and without angular elevations beset with pointed or spinuous projections ... ... *B. granularis.*

— Shell with fine, granulated spiral ridges with one, or at most two spiral rows of widely separated, pointed tubercles rendering these portions of the whorls somewhat angular 3

3. Edges of varices beset with rather long, strongly developed spines ; posterior canal with a somewhat backwardly directed spine ; tubercles between the varices strong and sharply pointed ... ... *B. spinosa.*

— Edges of varices not produced into spines, rounded ; posterior canal without projecting spine ; tubercles between the varices weaker and less sharply pointed ; shell broader in proportion to height ... ... *B. margaritula.*

Bursa granularis (Röding).

Plate XII, figs. 3*a* and 3*b*.

Tritonium granulare, Röding, Mus. Bolten., 1798, p. 127.
Ranella granifera, Lamarck, Anim sans vert., (Deshayes' edit.), IX, 1843, p. 548.
Ranella granifera, Reeve, Conch. Icon., II, 1844, *Ranella*, pl vi, fig. 30.
Ranella (*Colubrellina*) *granifera*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 119.
Bursa granularis, Crichton, Journ. Bomb. Nat. Hist. Soc., XLII, 1941, p 338.
Bursa granularis, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 45.

Though this species is represented in the collection by only two empty shells from the Pamban area, it is by no means uncommon in the Indian waters and has been recorded also from Madras, Tuticorin and Galle coast (Ceylon). The shell resembles very closely that of *Gyrineum natator* Röding, the whorls being encircled with regular spiral rows of rounded tubercles, and traversed by a pair of varices one on each side, forming continuous ridges ; but the presence of a well defined, deeply excavated posterior canal in the present species at once distinguishes it from *G. natator*, in which it is absent altogether ; further, in *B. granularis* the inside of the outer lip is provided with larger, more numerous and more close-set teeth, and the folds on the columella are more pronounced. Immediately below the suture there is a double row of smaller tubercles, the upper ones of which are flatter and laterally expanded. The shell from Krusadai Island is rather worn and slightly broken at the top ; it is pale orange-yellow, faintly banded with white ; but the second specimen from Kundugal Point is relatively fresh and of a deep reddish brown colour. Krusadai Island and Kundugal Point.

Bursa spinosa (Lamarck).

Plate XII, fig. 4.

Ranella spinosa, Lamarck, Anim sans-vert., (Deshayes' edit), IX, 1843, p. 545.
Ranella spinosa, Reeve, Conch. Icon , II, 1844, *Ranella*, pl. 11, fig 7.
Bursa spinosa, Gravely, Bull. Mad Govt Mus. (Nat. Hist.), V. No 2, 1942, p. 45.

The shell is larger and broader in proportion to its height than in the preceding species. The surface is ornamented throughout with close-set granular spiral ridges of rather unequal thickness ; those near the next upper suture are finer and more strongly granulated than the lower ones The shell is somewhat dorso-ventrally depressed, and the whorls are slightly angulated. The most characteristic feature of the shell, however, is the presence of strong spines ; each whorl has a pair of varices, one on each side forming a continuous ridge extending the entire length of the shell as in *B. granularis*, but in the present species these varices are produced into strong, elongated, outwardly directed spines at rather irregular intervals. There is also a single spine adjacent to the posterior canal ; this spine is directed backwards. In addition to the spines on the varices, there are one or two regular, spiral rows of widely spaced, short, pointed, spine-like tubercles. The edge of the outer lip presents a frilled appearance owing to the presence of strong, irregular, transverse teeth. The shell is uniformly pale or smoky brown. This species is very common at Madras where numerous shells have been collected from the beach, but relatively rare at Pamban, whence only a single shell is represented in the collection. Pamban.

Bursa rubeta (Linné).

Plate XII, fig. 5.

Murex lampas, Linné, Syst. Nat., Ed. X, 1758, p. 748, No. 454.
Triton lampas, Lamarck, Encyclopédie Méthodique, Vers, 1816, pl 420, Liste, p. 5.
Triton lampas, Reeve, Conch Icon., II, 1844, *Triton*, pl. ix, p. 626.
Ranella lampas, Smith, in Gardiner's Fauna and Geography of the Laccadive and Maldive Archipelagoes, II, 1906, p. 611.
Bursa (Bufonia) lampas, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 118.
Bursa rubeta, Gravely, Bull Mad. Govt Mus. (Nat Hist), V, No. 2, 1942, p. 44

The shell of this species is said to be extremely variable in size and often attains very large dimensions. The single Pamban shell contained in the Museum collection, however, is small, but there is a large and massive shell from the Laccadives in Mr. Crichton's collection, which provides interesting material for comparison. The shell is thick, with a very rough and coarse-looking surface bearing numerous, strong, irregular spiral ridges, many of which, especially the oblique ones at the base of the body whorl are strongly granulated. There are several strongly developed varices ornamented with strong, nodular, transverse ridges, and disposed on different radii on the different whorls. The spaces between the varices are traversed by additional transpiral ridges which generally take the form of one or two rows of strong, raised, angular, knob-like tubercles somewhat as in *Cymatium rhinoceros*, but in the present species these tubercles tend to be compressed and their edges are beset with rounded nodules. The columella bears fine, elongated, transverse ridges. The edge of the outer lip is thrown into folds and its inner margin bears a number of strong, widely spaced elongated teeth. The shell is pale browinish with scattered reddish markings, while the columella and interior of aperture are pale orange, which is well marked in the Laccadive shell, but almost bleached white in the Pamban specimen. Pamban.

Bursa margaritula (Deshayes)

Plate XII, figs. 6*a* and 6*b*.

Ranella margaritula, Lamarck, Anim. sans vert , (Deshayes' edit), IX, 1843, p 550.
Ranella margaritula, Reeve, Conch. Icon , II, 1844, *Ranella*, pl. iii, fig. 15.
Ranella margaritula, Watson, " Challenger ", Zoology, XV, 1886, Gastropoda, p 396.
Bursa margaritula, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 116.
Bursa margaritula, Gravely, Bull Mad Govt Mus (Nat. Hist), V, No. 2, 1942, p. 45.

The shell is smaller and broader in proportion to its height than in any of the preceding species of Bursa. The varices are strongly developed, traversed by coarsely granular transverse ridges and form two continuous ridges, one on either side of the shell. The surface of the shell is ornamented throughout with finely granulated spiral ridges. The whorls are angular in the middle, and the angulated part bears a row of rather blunt, compressed tubercles ; on the body whorl there are also usually one or two additional tubercles below the main row on the angle. The columellar border of the aperture bears a few, strong, somewhat wrinkled folds. The posterior canal is strongly deflected to the right, when seen

from the apertural side of the shell. The shells in the collection are rather faded and are uniformly pale yellowish brown, but traces of the original deep brownish colour are still seen especially on the tuberlces and near the sutures. Pamban.

Family TONNIDAE (=DOLIIDAE).

The shell is generally large, with spiral grooves or raised spiral ribs, a short spire and a very large, ovoid or globular, inflated body whorl. The aperture is very wide and bears a wide anterior canal, but no posterior canal. An operculum is absent. The foot is very large.

This family includes only a single genus, *Tonna* (= *Dolium*), comprising the shells popularly known as Tun shells.

Genus **Tonna** Brunnich, 1772.

[Syn **Dolium** (Argenville) Lamarck, 1801].

With the characters of the family.

Six species are recorded from Pamban ; they may be distinguished as follows :—

1. Surface of shell ornamented with distinct, raised, somewhat widely spaced, spiral ribs, sometimes with finer intermediate ribs between the main ones ... 2

— Surface of shell uniformly traversed throughout with more or less closely set spiral grooves, the interstices between the grooves being broad, flattened spaces seldom raised to form definite ridges ... 4

2. Shell somewhat thin, principal spiral ribs marked with alternate patches of white and dark brown ; fine intermediate spiral ribs present in the broad interspaces between the principal ribs, but unlike the latter, are uniformly whitish ... ... *T. dolium.*

— Shell thicker ; spiral ribs more numerous and close-set ; intermediate finer ribs absent, the interstices between the ribs being smooth ; body whorl slightly more elongately ovoid 3

3 Spiral ribs very broad, flattened ; interstices reduced to narrow, depressed spaces ; shell whitish, very boldly marked with four, broad, orange-brown spiral bands, the width of each of which being equal to about twice the width of a spiral rib ... ... *T. fasciatum.*

— Spiral ribs narrower, more strongly raised; interstices slightly broader; broad, coloured, spiral bands absent; ribs profusely spotted with brown, the spots being more numerous and close-set than in *T. dolium* ... ... *T. tessellata.*

4 Shell elongately ovate, with large, obliquely inflated body whorl and somewhat strongly elevated spire and pointed apex; surface uniformly spirally grooved, the interstices separated by the grooves being slightly raised and simulating broad, flattened spiral ribs; shell brownish throughout, marked profusely with curved white patches all over; grooves paler than interestices . .. . *T. perdix.*

— Shell less elongately ovoid; body whorl inflated, but less strongly oblique; spire considerably more depressed; spiral grooves on the surface very shallow, scarcely impressed; interstices between the grooves depressly flattened, colour not as above; grooves usually darker than the interstices 5

5 Shell rather thin, ovate, sutures deeply sunk in grooves; shell brownish, with scattered chestnut blotches and white patches all over .. ... *T. olearium.*

— Shell thicker, more globularly inflated; sutures simple, not sunk in grooves; pale chestnut-brown, irregularly marked all over with clouded white and dark brown patches .. .. *T. cumingii.*

Tonna dolium (Linné).

Plate XIII, figs. *1a* and *1b*.

Buccinum dolium, Linné, Syst Nat., Ed. X, 1758, p. 735.
Dolium maculatum, Lamarck, Anim sans vert, (Deshayes' edit), X, 1845, p. 140.
Dolium maculatum, Reeve, Conch. Icon., V, 1849, *Dolium*, pl III, fig 4
Dolium maculatum, Vredenburg, Observations on Doliidae, Mem. Ind Mus., VII, 1919, p. 150, pl. IV, figs. 1-3, pl. v, figs. 4-6.
Tonna dolium, Crichton, Journ. Bomb. Nat. Hist. Soc, XLII, 1941, p. 331.
Tonna dolium, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No. 2, 1942, p. 45.

This is the commonest species of *Tonna*, both in the Madras and Pamban areas. A large number of dead shells of varying sizes and a few live specimens have been collected from **Krusadai** and its vicinity. The shell is large, moderately thin, with a globular, inflated

body whorl, and short, flatly conical spire. The surface is ornamented with strong, raised, widely spaced, spiral ribs, and with much finer, secondary spiral ribs in the interstices between the principal ribs ; the median one of the finer ribs is usually slightly stronger than the rest, but yet much weaker than the main ribs. The columella is more or less straight and obliquely striated. The aperture is very wide and its interior marked by spiral depressions which correspond to the external ribs. The outer lip is simple, thin, and usually found broken in shells washed up on the beach The shell is whitish, or very pale bluish white, the principal ribs being marked with a bold pattern of alternating patches of white and dark yellowish brown. Pamban, Krusadai and Shingle Islands.

Tonna tessellata (Lamarck)

Plate XIII, fig. 2.

Dolium tessellatum, Lamarck, Tabl. Encyclopédie Méthodique, Liste, 1816, p. 3 (for pl. 403, fig. 3).
Dolium fimbriatum, Sowerby, Genera of Shells, 1827, pl 242, fig. 2.
Dolium fimbriatum, Reeve, Conch. Icon., V, 1849, *Dolium*, pl. iii, fig 3.
Dolium fimbriatum, Vredenburg, Observations on Doliidae, Mem Ind Mus., VII, 1919, p. 156, pl vi-viii, figs. 7-13.
Tonna tessellata, Oostingh, Shells of the Molluccas, Commun. Geol. Inst , Wageningen, IX, 1925, p. 125.

This species approaches the preceding one more closely than any others recorded from Pamban. It is represented in the collection by a single moderate-sized dead shell from Krusadai Island ; the edge of its outer lip is broken. As in *T dolium*, the shell is ornamented with a number of raised spiral ribs, but in this species they are more numerous and slightly more close-set, there being on the body whorl no less than thirteen to fourteen ribs, as against nine or ten in *T. dolium*. Further, the interestices between the ribs are smooth and not traversed by finer intermediate ribs. The columella is rather strongly twisted. The shell is pale brownish white, the ribs being marked with alternating spots of white and brown but the spots in this species are more numerous, duller and closer together than on the principal ribs of *T. dolium*. Krusadai Island.

Tonna fasciata (Bruguière).

Plate XIII, fig 3

Buccinum fasciatum, Bruguière, Encyclopédie Méthodique, Vers, 1789, p 247.
Dolium fasciatum, Lamarck, Anim sans vert , (Deshayes' edit.), X, 1845, p. 142.
Dolium fasciatum, Reeve, Conch. Icon., V, 1849, *Dolium*, pl vii, fig. 11.
Dolium fasciatum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 125.
Dolium (Eudolium) fasciatum, Vredenburg, Observations on Doliidae, Mem. Ind Mus., VII, 1919, p. 186. pl. iii, figs 4 and 5.
Tonna fasciata, Gravely, Bull Mad Govt Mus. (Nat Hist.), V, No. 2, 1942, p. 46.

Two dead shells, one with entire and the other with a slightly broken outer lip, are represented in the collection. The shell is moderately thin, with a large, ovately inflated body whorl and a short, conical spire. The sutures are slightly sunk in narrow, impressed

grooves. The surface is ornamented with numerous broad, somewhat flattened, close-set spiral ribs separated by flat, smooth interspaces of which the uppermost one in each whorl is rather broader than the rest. The columella is slightly twisted and the base of the shell is rather strongly constricted and produced. The umbilicus is very much reduced The shell is white, marked with four, broad, widely separated brownish spiral bands which, however, fade out before reaching the edge of the outer lip. The presence of these colour bands distinguishes this species readily from the remaining Pamban species. The outer lip is thickened and slightly reflected out at its edge. Pamban.

Tonna olearium (Bruguière).

Plate XIII, figs. 4*a* and 4*b*.

Buccinum olearium, Bruguière, Encyclopédie Méthodique, Vers, 1789, p 243.
Dolium olearium, Lamarck, Anim sans vert, (Deshayes' edit), X, 1845, p. 140.
Dolium olearium, Reeve, Conch. Icon., V, 1849, *Dolium*, pl viii, fig. 14
Dolium olearium, Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive *Archipelagoes*, *II*, 1906, p 611
Dolium olearium, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 125.
Dolium olearium, Vredenburg, Observations on Doliidae., Mem. Ind. Mus, VII, 1919, p. 185

The shell is thin, moderate-sized, with a large, very strongly inflated body whorl and short spire. The base of the shell is broad, and not narrowly porduced as in the preceding species The sutures are well sunk in deep channel-like grooves—a feature which readily distinguishes this species from the other Doliids recorded from Pamban The surface is uniformly traversed by shallow, somewhat widely spaced spiral grooves, separated by broad, flattened interspaces, too feebly raised to form definite ribs. The columella is almost straight and the umbilicus very much reduced. The edge of the outer lip is simple, not thickened. The shell is pale brown, marked with numerous white and chestnut spots ; the spiral grooves are darker than the interspaces. Two dead shells found washed up on the beach are represented in the collection. Krusadai and Shingle Islands.

Tonna cumingii (*Reeve*).

Plate XIII, *figs*. 5*a* and 5*b*.

Dolium cumingii, Reeve, Conch. Icon, V, 1849, *Dolium*, pl. viii, figs 13*b* and *c*.
Tonna cumingii, Hedley, Australian Tun shells, Rec Austr. Mus., XII, 1919, p 331.
Tonna cumingii, Winckworth and Tomlin, Genus *Tonna* (=*Dolium*), Proc Malac. Soc, XX, 1933, *p*. 209.
Tonna cumingii, Gravely, Bull. Mad. Govt. Mus (Nat Hist), V, No. 2, 1942, p. 46.

This species, represented in the collection by two rather worn shells, resembles the preceding one in its general shape and sculpture, but is easily distinguished from it by the sutures of the shell being normal and not sunk, and the spiral grooves more numerous and close-set. The shell is rather thick and the body whorl broadly ovoid or almost *globular*, with about twenty-one close-set spiral grooves separated by interstices which, however, are

not quite so depressly flattened as in *T. olearium* ; one or two of the uppermost grooves in each whorl are seen to be distinctly double. The columella is slightly twisted and the umbilicus open. The shell is pale brownish, marked with indefinite, clouded patches of white and dark brown disposed spirally. Krusadai Island.

Tonna perdix (Linné).

Plate XIV, fig. 1.

Buccinum perdix, Linné, Syst. Nat., Ed. X, 1758, p. 734
Dolium perdix, Fischer, Mus. Demid , III, 1807, p 182
Dolium perdix, Lamarck, Anim sans vert., (Deshayes' edit.), X, 1845, p. 144.
Dolium perdix, Reeve, Conch. Icon., V, 1849, *Dolium*, pl vi, fig. 9.
Dolium perdix, Vredenburg, Observations on Doliidae, Mem Ind Mus , VII, 1919, p. 186.

The shell is large and thin-walled, and differs from those of the other Pamban species in having a proportionately narrower and obliquely inclined body whorl and a more strongly elevated spire with a sharply pointed apex. The surface is traversed throughout by evenly spaced, somewhat shallow spiral grooves separated by rather broad, slightly raised interspaces which take the form of more or less definite ribs towards the basal portion of the body whorl. The aperture is wide, rather elongate, and more gradually narrowed above than in the preceding species. The single Pamban shell in the collection is somewhat worn and has the edge of the outer lip broken. It is pale yellowish brown throughout, but traces of the curved white patches characteristic of the species can be still seen below the sutures and towards the base of the shell ; there is, however, a fine, large, fresh shell from the Rameswaram shell bazaar which shows the colour very well, being bright brownish, and having a large violet patch in the interior of the aperture, but its exact locality is not known. Krusadai Island.

Order Stenoglossa.

SERIES MURICACEA.

Family MURICIDAE.

The species of shells included in this family present such a large range of variation in form, colour, ornamentation and sculpture that it is difficult to give a comprehensive definition of the characters of the family as a whole. The spire is usually moderately elevated ; the shell is often provided with strong varices which are either lamellated or spiny. The surface is generally spirally sculptured, with scaly or nodular ridges. The columella is usually smooth, without folds. The anterior canal is sometimes elongated, and so deeply grooved as to become an almost closed channel. The operculum is thin, with terminal nucleus. The foot is large and the mantle usually provided with glands for secreting a purple fluid from which a dye is prepared.

Five genera are represented in the Pamban area ; they may be distinguished as follows :—

1. Anterior canal long and narrow ; spire rather strongly elevated ; aperture generally small, rounded, or narrow and ovate ; varices present and well developed, occasionally spiny ... . *Murex.*

— Anterior canal shorter and more widely open ; spire generally a little less elevated ; aperture larger and wider ; varices mostly absent 2

2. Body whorl greatly enlarged ; spire comparatively small ; aperture very broad ; nucleus of operculum situated in the lower part of the outer side ; umbilicus usually present and large ... ... *Rapana.*

— Body whorl not particularly enlarged ; spire more elevated ; shell on the whole narrower and more elongate ; aperture slightly narrower and more ovate ; nucleus of operculum lateral or situated on the outer margin ; umbilicus reduced or absent ... 3

3. Shell markedly elongately ovate ; spire usually small and conical ; shell uniformly sculptured with very fine, close-set spiral grooves throughout ; aperture elongated and elliptical ... ... *Jopas.*

— Shell broader and less elongate ; spire usually larger and more elevated, though occasionally somewhat flatly conical ; sculpture not as above, usually stronger and tuberculated 4

4. Shell usually moderately small, as a rule with distinct transpiral ribs in addition to spiral ribs or ridges ; inside of outer lip of aperture more or less strongly toothed ... ... *Drupa.*

— Shell generally larger, variously shaped ; sculpture usually spiral ; inside of outer lip usually smooth ; body whorl usually with strong tubercles or nodules ; columellar lip generally broad and flattened ... ... *Thais (=Purpura).*

Genus **Rapana** Schumacher, 1817.

The shell is generally large and thick, mostly umbilicated ; the spire is small, but the body whorl is large and often inflated. The aperture is more or less broad, with short, widely open anterior canal.

A single species is represented at Pamban ; this is also the only species of the genus recorded from the Madras area.

Rapana bulbosa (Dillwyn).

Plate XIV, figs. 2*a* and 2*b*.

Buccinum bulbosum, Dillwyn, Catalogue of Shells, 1817, p. 631, No. 104.
Pyrula bulbosa, Reeve, Conch. Icon., IV, 1847, *Pyrula*, pl. iv, fig. 14.
Rapana bulbosa, Watson, " Challenger ", Zoology, XV, 1886, Gastropoda, p. 173.
Rapana bulbosa, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 136.
Rapana bulbosa, Crichton, Journ. Bomb. Nat. Hist. Soc., XLII, 1941, p. 325.
Rapana bulbosa, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No 2, 1942, p. 48.

This species is rather uncommon at Pamban, and represented in the collection by only a few dead shells from that locality, though a large number of specimens have been collected, particularly by Mr. Crichton, from the Madras beach. The shell is large, with a very low spire and a broad, inflated body whorl. The surface is traversed throughout by fine, close-set spiral striae, and also ornamented with a spiral row of small, rounded, tubercle-like processes, which extend even to the whorls of the spire ; in the body whorl, however, there may be one or two more incomplete rows of such tubercles below the principal one. The sutures are more or less markedly sunk in broad grooves. The base of the body whorl is strongly narrowed. The umbilicus is very large and has a wide opening. The columellar surface is covered by a whitish, polished callus thickening. The aperture is very large and is produced into a short, widely open anterior canal. The surface of the shell is pale brownish throughout, and the interior of the aperture white. Pamban.

Genus Murex Linné, 1758.

The shell is usually considerably large, with moderately high spire, and as a rule, with distinct, and often spiny varices , the aperture is more or less large, ovate, or almost rounded, with a well developed anterior canal which is either short, or greatly elongated, open or closed.

As a rule, living specimens of *Murex* are rare on the reefs ; they are, however, more plenteous in deeper waters and have been occasionally brought up by the dredge ; the Pamban specimens of *Murex* in the Museum collection comprise mainly dead shells.

Six species of this genus are represented at Pamban ; they may be distinguished as follows :—

1. Shell small, fusiform ; varices traversed by simple transverse ridges ; anterior canal only very slightly produced ... ... *M. badius.*

— Shell larger, with the body whorl broader ; varices usually decorated with variously shaped processes ; anterior canal often more elongate, sometimes very greatly so 2

2. Shell rather thick and massive ; processes on varices flattened and foliaceous ; anterior canal of about the same length as, or even shorter than the spire, and open 3

— Shell thinner ; processes on varices, when present, long and spiniform ; anterior canal greatly elongated, very much longer than the spire, and for the most part closed and tubular 4

3. Processes on varices very numerous and markedly foliaceous ; ridges on the whorls strong and somewhat widely spaced ; maximum width of shell only about half its total length ; outer surface of shell coal-black ... . *M. adustus.*

— Processes on varices smaller, less numerous and less intensely foliaceous ; ridges on the whorls finer and more closely set ; maximum width of the shell more than three-fourths of its total length ; outer surface of shell pale brownish ; shell comparatively thick and heavy 5

4. Varices without processes ; surface of shell transpirally traversed by tuberculated ridges, body whorl more or less globular and strongly inflated; columuellar lip of aperture protruding strongly beyond the level of the body whorl ... ... *M. haustellum.*

— Varices with strong, elongated, spiniform processes ; surface of shell traversed by close-set spiral ridges which are not tuberculated; body whorl relatively small and less strongly inflated; columellar lip of aperture not appreciably protruding beyond the level of the body whorl ... ... *M. tribulus var. trapa.*

5. Shell very thick, solid, heavy; varices very stout, forming broad, rounded ridges; processes on varices few, wide apart and poorly developed ... ... *M. virgineus var. ponderosa.*

... ...

— Shell thinner and lighter; transverse striae on surface stronger, and somewhat more conspicuously granular; varices thinner and narrower; processes on varices more numerous, closer together and more strongly developed ... ... *M. virgineus s. str.*

Murex badius Reeve.

Plate XIV, figs. 3*a* and 3*b*.

Murex badius, Reeve, Conch. Icon., III, 1845, *Murex*, pl. xxxii, fig. 159.

This species is rare at Pamban, and represented by only two dead shells in the collection. The shell is readily distinguished from those of all the other succeeding species by its remarkably small size and spindle-shape; there are about seven varices, which, except for being transversely ridged like the rest of the surface, are not specially ornamented with spines or processes. The spire is raised and well developed. The anterior canal is short, open and slightly curved. The inside of the outer lip of the aperture is traversed by feebly developed, parallel, transverse ridges. Of the two shells in the collection, the smaller one is pale brownish while the larger is almost bleached white; but even the former has not fully retained its original colour which is a characteristic reddish brown. Pamban.

Murex trapa Roding.

Plate XIV, fig. 4.

Murex trapa, Röding, Mus Bolten, 1798, p. 145.
Murex martinianus, Reeve, Proc. Zool. Soc. London, 1845, p. 88
Murex martinianus, Reeve, Conch. Icon., III, 1845, *Murex*, p. xviii, fig 72.
Murex martinianus, Kobelt, Conch. Cab., Ed II, 1869, *Murex*, p. 59, pl. ix, fig. 3.
Murex rarispina, Sowerby, Thes. Conchyl, IV, 1879, *Murex*, p. 2, pl. 1, fig. 2.
Murex martinianus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 343.
Murex trapa, Crichton, Journ. Bomb. Nat. Hist. Soc, XLII, 1941, p 331
Murex tribulus var trapa, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 49 (foot-note).

Dr. Gravely, in his paper on Madras Shells, cited above, treats this as a variety of *Murex tribulus* and considers that the two forms are not sufficiently distinct as to rank as different species; as, however, a single fine Krusadai shell has been definitely identified by Mr. Winckworth as belonging to the species *M. trapa* owing to the fact that it is distinctly distinguished from *M. tribulus* by the absence of additional rows of spines, reduced number of spines on the anterior process, and the presence of an enlarged tooth on the outer lip below the middle, it has been found necessary to record it in the present paper as a distinct species. A living specimen dredged off Krusadai Island is represented in the collection of the Madras Christian College Museum.

The shell is moderately thin, with a rounded, somewhat inflated body whorl, a well developed, turretted spire, and a greatly elongated, narrow, attenuated anterior canal which is almost entirely covered up along the apertural surface so as to become a more or less completely closed tube. The whorls are strongly angularly shouldered round the upper part. The surface is strongly spirally ridged, the ridges being slightly raised into imperfectly developed nodular swellings which are specially pronounced on the angular parts of the whorls. There are three strong varices, each armed with a few, strong, moderately elongated and somewhat widely spaced spines, the upper ones of which generally tend to be slightly upwardly curved ; the spines are finely grooved on their flattened surfaces. The varices with the accompanying spines are produced along the sides of the tubular anterior canal for the greater part of its length. The edge of the outer lip is produced into two or three short, conical, lamina-like teeth of which the one just below the middle is the largest and projects most. The lowermost part of the anterior canal is devoid of spines. The outer surface of the shell is pale yellowish brown, while the interior of the aperture is whitish, heavily stained with dark brown. Krusadai Island.

Murex haustellum Linné.

Plate XIV, fig. 5.

Murex haustellum, Linné, Syst. Nat., Ed. X, 1758, p. 746, No. 443.
Murex haustellum, Reeve, Conch Icon., III, 1845, *Murex*, pl. xxiii fig. 95
Murex haustellum, Sowerby, Thes Conchyl., IV, 1879, *Murex*, p 5, pl. ii, fig. 17.
Murex (Tribulus) haustellum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 344.
Murex haustellum, Hornell, Common Molluscs of South India, Mad. Fish. Bull, XIV, 1921, p. 134.
Murex haustellum, Gravely, Bull Mad. Govt. Mus (Nat Hist.), V, No. 2, 1942, p. 49.

This species is common in the Eastern seas, but represented in the collection only by two dead shells from Pamban, though there are numerous shells from Madras. The shell resembles that of the preceding species in having a much elongated, closed anterior canal, but differs from it in several other important respects. The body whorl is decidedly more strongly inflated, markedly globular, and even somewhat compressed antero-posteriorly. The whorls are angularly shouldered as in *M. trapa*, but the base of the spire is considerably broader and the height of the spire proportionately less. In addition to the three varices which, except for striations and slight nodular elevations, do not bear any definite processes, there are several stout, strongly nodular transpiral ridges ; the tubercles of these ridges are strongest at the angular parts of the whorls, and these are moreover somewhat compressed, much as in *Bursa rubeta*. Spiral striae are present throughout the surface, but they are very much finer and more close-set than in *M. trapa*. The columellar lip of the aperture is strongly exserted and meets the outer lip posteriorly, as well as anteriorly over the commencement of the anterior canal so that the aperture is completely walled in by a raised border all round. The shell is pale brownish, marked with spiral rows of dark brownish spots. The varices are traversed by square brown patches. Pamban.

Murex virgineus (Röding).

Purpura virginea, Röding, Mus. Bolten., 1798, p. 141.
Murex anguliferus, Lamarck, Anim. sans vert., (Deshayes' edit.), IX, 1843, p. 588.
Murex anguliferus, Reeve, Conch. Icon., III, 1845, *Murex*, pl. xi, fig. 43.
Murex virgineus, Crichton, Journ. Bomb. Nat. Hist. Soc., XLII, 1941, p. 330.
Murex virgineus, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 49.

A single, small, spirit-preserved specimen from Rameswaram is the sole representative of this species in the collection from the Pamban area, but its variety, *ponderosa*, to be dealt with presently, appears to be much commoner in this locality. The shell is moderately thin, with the body whorl broad above and rather strongly narrowed and produced below, its profile thus assuming roughly the shape of an inverted triangle. The surface is strongly spirally ridged, the ridges being finely granular. There are three varices, somewhat thickened and ornamented with short curved processes, which are fairly numerous and not very widely separated. There is a large, raised, transpirally elongated, knob-like tubercle in each of the three wide interspaces between the varices. The whorls are not as distinctly angled as in the two preceding species. The anterior canal is moderately elongate, curved and partially closed. The surface is pale brown, while the interior of the aperture is white, tinged with pink. Rameswaram.

Murex virgineus var. **ponderosa** Sowerby.

Plate XV, figs. 1*a* and 1*b*.

Murex ponderosus, Sowerby, Thes. Conchyl., IV, 1879, *Murex*, pl. 387, fig 67.
Murex virgineus var. ponderosa, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 49.

The shell in this variety closely resembles that of *M. virgineus s. str.* in shape and general proportions, but differs from it in so many important respects that it has been treated by Sowerby as a distinct species. The shell is not only much thicker, heavier and more massive, but also relatively broad in proportion to its total length. The surface is traversed by close-set, fine, unequal spiral ridges, most of which are minutely granulated. The wide interspaces between the varices bear tubercles as in the preceding form. The varices are much stouter and more raised, and their folded processes are few, poorly developed and widely spaced. The columella bears a smooth, polished callus layer ; this and the outer lip are edged with pink, while the rest of the interior of the aperture is whitish. The anterior canal is moderately long and is partially closed by a broad, horizontal fold from the basal prolongation of the body whorl. The outer surface is pale brown. Kundugal Point and Pamban.

Murex adustus Lamarck.

Plate XV, figs. 2*a* and 2*b*.

Murex adustus, Lamarck, Anim. sans vert., (Deshayes' edit.), IX, 1843, p. 573.
Murex adustus, Reeve, Conch. Icon., III, 1845, *Murex*, pl. viii, fig 29.
Murex adustus Sowerby, Thes. Conchyl., IV, 1879, *Murex*, p. 16, pl. iv, figs 42 and 43.
Murex (*Chicoreus*) *adustus*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 346.
Murex adustus, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 48.

This species, though rather uncommon at Pamban, is said to be widely distributed in the Eastern seas, and frequently sold as an ornamental shell at Rameswaram. The shell is readily distinguished from those of the preceding species by the coal-black colour of the surface layer and by the intensely foliaceous and thick-set processes with which the varices are ornamented. In each of the three interspaces between the varices, there is a very large, raised, and more or less rounded, knob-like tubercle which is much broader and much less transpirally elongate than the corresponding one in the preceding species. The surface is traversed by strong, raised, somewhat widely-spaced spiral ridges, the interstices between which are finely and closely spirally striated. The aperture and the anterior canal are much the same as in *M. virgineus*, but the shell, on the whole, is much narrower and more typically fusiform than in that species. The entire surface of the shell is jet-black, except for a few traces of the brownish, almost entirely obscured ground colour which shows out here and there, especially in between the spiral ridges at the sides of the varices. The interior of the aperture is bluish white. One shell from Pamban is heavily covered with encrustations almost beyond recognition but the black colour and transverse ridges still seen on portions of the surface readily reveal its identity. Its coal-black colour accounts for the popular name—the burnt Murex—for the shell of this species. Shingle Island and Pamban.

Genus **Drupa** (Bolten) Röding, 1798.

The shell is usually small with low or conical spire and as a rule with distinct sculpture ; the inside of the outer lip of aperture is more or less strongly toothed. The anterior canal is short and open. The nucleus of the operculum is situated at the outer margin.

It is mainly in view of the difficulty of separating the genus *Drupa* from *Thais* solely by means of shell characters, that Dr. Gravely has included both under the common generic head, *Thais*, in his paper on Madras shells ; but for the sake of consistency with Thiele's classification, it has now been considered desirable to treat the two as distinct from one another. It might, however, be helpful to point out that, as a rule, forms referred to by Reeve as *Purpura* generally correspond to species of *Thais*, and those included by him under *Ricinula* to species of *Drupa*, the latter being usually distinguished from the former by the shell being smaller, with the aperture much narrowed by nodulous teeth projecting inwards from the outer lip and by the columellar lip being a little excavated. Schepman uses the names *Sistrum* and *Cuma* as synonyms for *Ricinula* and *Thais*, respectively.

Two sub-genera of *Drupa*, namely, *Drupa s. str.* and *Maculotriton* are represented. Of these the latter includes one, and the former all the remaining species recorded from Pamban. *Maculotriton* is readily distinguished from *Drupa s. str.* by the shell being rather slender, with a more strongly elevated spire and by the ridges on the inner surface of the outer lip of the aperture being finer and more numerous.

Sub-genus **Drupa** s. str.

The Pamban species of this section of the genus may be distinguished as follows :—

1. Shell moderately large, very thick, solid, broadly rounded, with very large, widely spaced, rounded tubercles arranged in four or five spiral rows ; spire very low ; almost entirely obscured ; columella and outer lip coloured bright violet ; outer lip produced outwards into short, pointed processes ; columella with transverse folds	*D. horrida.*
— Shell smaller, less massive, narrower and more nearly spindle-shaped ; sculpture usually consisting of spiral ridges and transpiral ribs ; tubercles when present smaller, more numerous and close-set ; columella and outer lip not coloured as above ; outer lip without outwardly projecting processes ; columella generally smooth	2.
2. Shell broadly ovate, with short spire, ornamented with uniformly well developed spiral rows of close-set, blackish, rounded, often glossy tubercles, the interstices between which are pale or greyish ; spire usually found eroded and appearing depressed in most reef-dwelling specimens	*D. tuberculata.*
— Shell narrower and more elongate ; spire more strongly elevated ; sculpture consisting of spiral striae and broadly rounded transpiral ribs, the latter usually predominating over the spiral sculpture ; spirally arranged rounded tubercles absent	3.
3. Shell less than twice as long as broad ; aperture moderately wide ; transpiral ribs ornamented with compressed nodules which are just raised portions of the stronger spiral ridges	4.

— Shell longer in proportion to the breadth, being fully about twice as long as broad ; aperture very narrow and reduced ; transpiral ribs ornamented with scaly processes ; spiral sculpture consisting of more or less uniformly strong spiral striae, which are not raised on the sites of the transpiral ribs ... ... *D. chrysostoma.*

4. The stronger of the spiral ridges blackish or dark brown, the broad, interstitial spiral spaces between them being whitish ; the widest middle part of the shell rendered more or less strongly angular by the transpiral ribs being markedly shouldered ; teeth on the inside of the outer lip absent or poorly developed ... ... *D. margariticola.*

— Shell pale brownish, heavily and irregularly stained with blackish brown markings all over ; the widest middle part of the shell less sharply angular, the transpiral ribs being more or less evenly rounded and not sharply shouldered ; teeth on the inside of the outer lip present and strongly developed ... ... *D. heptagonalis.*[1]

Drupa margariticola (Broderip).

Plate XV, figs. 3*a* and 3*b*.

Murex margariticola, Broderip, Proc. Zool Soc London, 1832, p. 177.
Murex fiscellum, etc , Chemnitz, Conch. Cab , X, 1788, p. 292, pl 192, figs. 1831 and 1832
Purpura fiscella, Kiener, Coq. Viv , VIII, 1836, *Purpura*, p. 30, pl. vi, figs. 12 and 12*a*.
Ricinula fiscellum, Reeve, Conch. Icon , III, 1845, *Ricinula*, pl. iv, fig 28.
Sistrum (Morula) fiscellum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 357
Thais margariticola, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No 2, 1942, pp. 50 and 53.

This is one of the commonest Gastropods inhabiting the reefs and living specimens may be seen adhering to stones and dead corals in large numbers in company with specimens of some of the larger species of *Cerithium* and of the next two species. The shell is small, rather broadly spindle-shaped, the wide middle part of the shell being more or less strongly angular. The spire is conical and sharply pointed. The surface is traversed by fine spiral ridges, a few of them at regular intervals being stronger and more raised than the rest. The transpiral ribs which are more pronounced than the spiral sculpture are strongly and angularly

[1] This species is treated only as a variety of *D margariticola* by Dr. Gravely in his paper on Madras shells ; but numerous Pamban shells of both forms have been collected alive, and as the differences between them are sufficiently distinct, they have been treated as separate species in this account.

shouldered at the angular part ; the principal spiral ridges are raised into more or less compressed nodules, those at the angular part being the strongest and most pronounced. In most of the Pamban shells the teeth on the inside of the outer lip are usually, but not invariably, absent, or poorly developed. The shell is generally very dark-coloured : the principal spiral ridges are dark or blackish brown, while the interstices between them are whitish ; the interior of the aperture is pale purplish. Krusadai Island, Kundugal Point, Pamban and Shingle Island.

Drupa heptagonalis (Reeve).

Plate XV, figs. 4*a* and 4*b*.

Ricinula heptagonalis, Reeve, Conch. Icon , III, 1845, *Ricinula*, pl iii, fig. 17.
Thais margariticola var. heptagonalis, Gravely, Bull Mad. Govt Mus. (Nat. Hist.), V, No. 2, 1942, pp. 50 and 53.

This species is even more abundantly represented than the preceding one in the Pamban area. It has been treated as a variety of the latter by Dr. Gravely in his account of Madras shells, but on comparing a large series of live Pamban specimens of this species with a similar series of the preceding one from the same locality, it is readily seen that the differences between them are sufficiently well marked as to justify their being treated as separate species. Living specimens of this species abound on the reefs, their shells being usually corroded to a greater or less extent, and covered with a characteristic purplish red encrustation. The shell is readily distinguished by its broad, transpiral ribs (of which there are about seven) being more or less evenly rounded, and not angularly shouldered as in the preceding species. The spiral ridges are more uniformly developed, the main ridges being less sharply differentiated from the intervening ones. The inside of the outer lip bears a few, strong, transversely elongated teeth. The shell is whitish, irregularly marked with diffuse patches of dark or blackish brown, generally disposed in the form of indistinct bands ; the columella and interior of the aperture are pale violet A single dead shell collected from Kundugal Point in 1928 and illustrating all the typical characters of the species, has been identified by Mr. Winckworth as *Morula heptagonalis*, *Morula* being a synonym for *Drupa*. Later, numerous specimens, both live ones and empty shells have been collected from various other localities. Pamban, Kundugal Point, Krusadai and Shingle Islands.

Drupa tuberculata (Blainville).

[Syn. **Drupa granulata** (Duclos)].

Plate XV, fig. 5.

Purpura tuberculata, De Blainville, Nouv Ann. du Mus., I, 1832, p. 204
Purpura tuberculata, Kiener, Coq Viv., VIII, 1836, pl ix, fig. 1. *Purpura*, p 22, pl. v, fig. 10.
Ricinula tuberculata, Reeve, Conch. Icon , III, 1846, *Ricinula*, pl ii, fig. 11.
Sistrum (Morula) tuberculatum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 355.
Thais granulata, Graevly, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 50.

This is another very common species inhabiting the reefs at Pamban. Numerous specimens have been collected alive from under blocks of stone and dead coral on the reefs, especially on the south side of Krusadai Island. The shell is somewhat small, broadly ovate and more or less typically spindle-shaped. In a few specimens, notably in a dead shell collected at Kundugal Point in 1928, and identified by Mr. Winckworth as *Morula tuberculata*, the spire is well raised and its apex sharply pointed ; this is the typical condition in the species ; but in the majority of specimens collected (both dead and alive) the spire is badly worn out and consequently depressed to a greater or less extent and its apex eroded, blunt, and even altogether obsolete. The shell may at once be distinguished by its characteristic sculpture. The surface is traversed throughout by uniformly stout, squarish, blackish tubercles arranged in regular spiral rows ; the width of the interstices between the spiral rows is more or less uniform, but generally the two rows of successive whorls adjoining each suture are drawn closer together than the rest. The interstices (and in fresh shells even the surfaces of the tubercles) are finely spirally striated, but the striae are indistinct in worn and corroded shells. The tubercles are blackish brown or almost coal-black, while the interstices are pale ashy brown ; the outer lip bears nodulous white teeth on the inside ; the columella and the aperture are blackish violet. Krusadai Island, Kundugal Point and Pamban.

Drupa horrida (Lamarck).

Plate XV, figs. 6*a* and 6*b*.

Ricinula horrida, Lamarck, Anim sans vert., Ed. II, Vol. X, 1845, p 47.
Purpura horrida, Kiener, Coq Viv , VIII, 1836, *Purpura*, p. 8, pl. 1, fig. 1.
Ricinula horrida, Reeve, Conch. Icon , III, 1846, *Ricinula*, pl 1, fig. 3
Sistrum horridum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 355.

Two good specimens from Pamban are represented in Mr. Crichton's collection, but worn and corroded shells of this species have been occasionally found washed up on the beach, especially on Shingle Island. The shell is considerably larger than those of the preceding species, very thick and solid, and bears a very low and almost totally depressed spire ; the body whorl appears rather swollen, and its surface bears large, short, conical, pointed tubercles, somewhat widely spaced and arranged in about four or five regular spiral rows. In worn shells, the tubercles tend to lose their conical, pointed form, and become blunt and rounded. The aperture is greatly reduced and rendered more or less linear by the enormously thickened outer lip which is produced into short, conical processes on the outside, and very strongly toothed on the inside. The columellar surface is rather extensive and strongly transversely toothed towards the basal part ; both the columellar surface and apertural surface of the outer lip are highly polished in fresh shells. The tubercles are blackish brown, the interstitial spaces whitish, while the columella, aperture and the inside of the outer lip are bright violet. Pamban and Shingle Island.

Drupa chrysostoma (Deshayes)

Murex chrysostoma, Deshayes, Magasin de Zool , 1844, Mollusca, pl 86
Ricinula chrysostoma (pars) Reeve, Conch Icon , III, 1846, *Ricinula*, pl ii, fig. 12*a*.
Purpura biconica, Kiener, Coq Viv., VIII, 1836, *Purpura*, p 28, pl. ix, fig 24
Sistrum biconicum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 355.

This species is described by Reeve as being extremely variable, but the form with spines, represented by fig. 12*b* in Reeve's Conchologia, III, pl. ii, is distinguished as *Drupa spinosum* by A Adams, while that with short tubercles only has been separated as *Drupa biconicum* (fig. 12*a* of Reeve) ; it is to this latter form that the single specimen represented in Mr. Crichton's collection belongs. The shell is thick, somewhat narrow and elongately ovate, with a much elevated spire. The whorls are angulated near the sutures ; the surface is roughly transversely striated throughout. There are a few widely spaced, strongly raised, transpiral ribs somewhat obscurely tuberculated. The aperture is narrow and ovate, the anterior canal short and open and the columella smooth, with a thin deposit of callus. The outer lip bears on the inside about six transversely elongated teeth. The single shell in Mr. Crichton's collection is somewhat corroded and covered with a whitish encrustation. The portions of the surface left uncovered by the encrustation are dull greenish grey. The columella and interior of the aperture are pale purplish brown. Pamban.

Sub-genus **Maculotriton** Dall, 1904.

A single species, *M. serrialis*, represented by a single rather worn shell in Mr. Crichton's collection, is recorded from Pamban.

Maculotriton serrialis (Laborde).

Plate XV, fig. 7

Buccinum serriale, Laborde (?) Voyage de l'Arabie Petree, 1834, p 66.
Triton bracteatus, Hinds, Zool. Voyage Sulphur, 1844, p. 11, pl. iv, figs 5 and 6.
Triton bracteatus, Reeve, Conch Icon , II, 1844, *Triton*, pl. xviii, fig. 34.
Maculotriton bracteatus, Dall, Smithson. Coll , XLVII, 1904, p 136
Maculotriton serrialis, Tomlin & Salisbury, Proc. Malac Soc., XVIII, 1928, p. 33.

A single, rather beach-worn shell, identified by Mr. Winckworth, is represented in Mr. Crichton's collection. The shell is small, rather narrow and elongate, and not unlike that of a small *Cerithium* in shape and appearance. The spire is strongly elevated and bears about five to six whorls. The body whorl is elongately ovate. The surface of the shell bears strong transpiral ribs crossed by close-set spiral ridges which are rendered strongly nodular by the presence of the former ; these spiral ridges are alternately strong and weak ; the finer details of the sculpture, however, are somewhat obscured in the single worn shell

which was available for examination. The outer lip is strongly thickened at the margin and transversely toothed within. The columella is arched, sparingly covered with callus, and bears a smooth surface. The aperture is ovate and bears a small posterior notch, while the anterior canal is short and deep. The shell is whitish, encircled with brownish spiral bands. Pamban.

Genus **Jopas** H. & A. Adams, 1853.

[Syn. **Nassa** (Bolten) Röding, 1798].

The shell is elongately ovoid, with a moderately short, conical spire and entirely devoid of varices or transpiral ribs, but with a very fine, closely grooved, uniform, spiral sculpture. A single species, represented only by dead shells, has been recorded.

Jopas sertum (Bruguière).

Plate XV, fig 8.

Buccinum sertum, Bruguière, Encyclopédie Méthodique, Vers, 1789, p 262

Purpura sertum, Kiener, Coq Viv , VIII, 1836, *Purpura*, p 133, pl 41, fig. 96.

Buccinum sertum, Reeve, Conch Icon , III, 1846, *Buccinum*, pl vi, fig. 42

Iopas sertum, Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, 1906, p. 609

Jopas sertum, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 353.

The shell of this species may be readily distinguished from those of all other Muricidae recorded from Pamban by the entire absence of spines, tubercles, nodules or varices. The shell is rather strongly elongately ovoid, and more or less spindle-shaped, with a short, conical spire, the whorls of which are scarcely inflated. The whorls are smoothly rounded, and, instead of being angular or shouldered at the upper part, are slightly concavely depressed above, this depression being well marked only on the body whorl which is elongated and inflated. The surface is uniformly traversed throughout by very fine, close-set, spiral grooves. The aperture is wide, ovate, but constricted posteriorly by two, tooth-like nodules covered with callus, one on the columella, and the other on the outer lip. The columella lip is somewhat arched, and the anterior canal wide open and represented by little more than a widely excavated notch at the lower end of the aperture. The surface is bright yellowish brown or orange-brown, faintly and irregularly marked with whitish and dark reddish brown patches. The columella and interior of the aperture are pale yellowish white. Pamban and Shingle Island.

Genus **Thais** (Bolten) Röding, 1798.

(Syn. **Purpura** Bruguière, 1792).

The shell is of variable size and form, generally with a more or less inflated body whorl and moderately short spire. The aperture is on the whole wider than in *Drupa* and the

inner border of the outer lip, except for being striated or wrinkled, is not beset with strong, nodular teeth as in *Drupa*. The sculpture is variable, either tuberculated, nodular or ridged.

The five Krusadai species of *Thais* may be distinguished with the aid of the following key :—

1. Surface of shell not particularly rough or coarse-looking, uniformly spirally grooved and traversed by three or four evenly spaced, prominent spiral ridges, or with one or two rows of widely spaced, large, rounded nodules ; whorls not strongly shouldered ... 2

— Surface of shell rough and corase-looking, strongly and irregularly spirally ridged and striated ; whorls strongly shouldered ; at least four of the spiral ridges on the body whorl stronger and more prominent than the rest ; the one at the shoulder being the strongest ; processes on the strong ridges tuberculated or scale-like and spiny 3

2. Shell very broad, with comparatively low and depressly conical spire ; body whorl with two rows of widely spaced, large, rounded nodules, the upper one of which is more prominent, and situated on a slightly angulated part of the whorl, and the lower one a little below it. Columella with a very thick deposit of callus especially at the upper part ... ... *T. bufo.*

— Shell somewhat narrower and more elongate, and with a more elevated spire ; body whorl with about four or less, evenly spaced spiral ridges, the interven-ing spaces being closely spirally grooved ; spiral ridges almost smooth, their processes being obsolete ; but the surface of these ridges marked with a bold pattern of alternating patches of white and dark brown ; colu-mella much less strongly thickened with callus ... *T. rudolphi.*

3. Processes on the strong spiral ridges very large, coarse, and in the form of pointed and more or less compressed tubercles ; interstices between the spiral rows of processes much reduced on account of the great size of the processes ; inside of outer lip heavily

blotched with dark purplish brown, and bearing four strong, nodular teeth, which get successively smaller from above downwards ... ... *T. intermedia.*

— Processes on the strong spiral ridges comparatively small and less coarse-looking; interstices between the spiral rows of processes wider; inside of outer lip paler and without strong, nodular teeth 4

4. Shell rather small, processes on strong spiral ridges not strongly raised, and in the form of blunt, depressed nodules which give the ridges an undulating profile, these principal ridges being really composed of two or three closely running, parallel, finer ridges; ridge at the shoulder strongest and the three below successively weaker; interstices between the main ridges traversed by smoother and finer ones ... *T. tissoti.*

— Shell larger, more strongly shouldered; processes on the whole larger, more sharply raised, and in the form of strongly folded, prickly scales which are strongest on the first spiral ridge at the shoulder, less markedly developed on the second, and rather poorly developed on the third and the fourth. Interstices between the principal spiral ridges finely scaled ... ... *T. rugosa.*

Thais rudolphi (Lamarck).

Plate XVI, fig. 1.

Purpura rudolphi, Lamarck, Anim. sans vert, (Deshayes' edit.), X, 1845, p. 60.
Purpura rudolphi, Reeve, Conch. Icon., III, 1846, *Purpura*, pl 11, fig 10.
Purpura rudolphi, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 135.
Thais rudolphi, Crichton, Journ Bomb Nat Hist Soc, XLII, 1941, p 338
Thais rudolphi, Gravely, Bull Mad. Govt Mus (Nat. Hist), V, No. 2, 1942, pp 49 and 52.

This is one of the most abundantly occurring species of *Thais* represented at Pamban, a large number of specimens being found alive on exposed rocks on the reefs at low tide. The shell is somewhat large, blackish brown, and broadly spindle-shaped, with a more or less even surface which is entirely devoid of raised tubercles or processes of any sort. There are about four or five widely spaced spiral ridges which are at most very feebly raised and not distinctly standing out as such; the processes on these ridges are almost entirely obsolete. Of these ridges, only the two uppermost ones are relatively well marked, those below them being

scarcely raised, and distinguished more by their characteristic colouration. The site of the uppermost ridge is marked only by a slight angulation, and not definitely shouldered as in most of the other species. The wide interspaces between the ridges are uniformly and finely spirally grooved. The aperture is large, ovate, with a moderately thin outer lip, which is slightly notched above and the inner surface of which is finely transversely grooved. The columella is almost straight and obliquely grooved. The operculum is horny and elongately ovate. The shell, in fresh condition, is blackish brown, sparsely blotched with white ; but the spiral ridges are almost always distinctly marked with alternating patches of black and yellowish white ; in worn shells the ground colour tends to become reddish brown ; the columella is yellowish, and the interior of the aperture whitish, edged with dark brown. Many of the shells taken alive on the reefs are found to have a dark purplish encrustation on the surface. Pamban, Kundugal Point, Krusadai and Shingle Islands.

Thais bufo (Lamarck).

Plate XVI, fig. 2.

Purpura bufo, Lamarck, Anim. sans vert., (Deshayes' edit.), X, 1845, p. 69.
Purpura bufo, Reeve, Conch Icon , III, 1846, *Purpura*, pl. 11, fig. 7.
Purpura bufo, Hornell, Common Molluscs of South India, Mad Fish. Bull., XIV, 1921, p. 135.
Thais bufo, Crichton, Journ Bomb. Nat. Hist. Soc., XLII, 1941, p. 333.
Thais bufo, Gravely, Bull. Mad Govt Mus. (Nat Hist.), V, No. 2, 1942, p. 52.

This species, living specimens of which commonly occur among rocks at Madras and Covelong, appears to be relatively rare at Pamban, only a single specimen, collected alive from this locality being represented in the collection. The shell is thick, large, and much broader than that of *T. rudolphi*, with a very low spire and more or less broadly inflated body whorl. The surface of the shell is uniformly spirally grooved throughout and on the body whorl there are two spiral rows of rather widely set, rounded tubercles, those of the upper row, whose site is marked by an obtusely angular shoulder, being the larger ; below these rows of nodules there are two slightly raised spiral ridges, but they are not tuberculated. The aperture is broad with a slightly arched columellar border covered by a thick, polished callosity which is particularly prominent posteriorly. The outer lip is thick, finely crenulated within and deeply notched at the upper extremity. The operculum is very broadly ovate. The shell is pale brown, faintly banded with dark brown on the surface, and the columella and interior of the aperture are yellowish brown. Pamban.[1]

[1] The variety *T. bufo, var. callosa*, reported by Dr. Gravely from the Madras area is not represented at Pamban.

Thais rugosa (Born).

Plate XVI, fig. 3.

Murex rugosus, Born, Index Mus. Caes Vindobon, 1778, p. 303
Purpura sacellum, Reeve, Conch. Icon., III, 1846, *Purpura*, pl xi, fig. 58.
Thais rugosa, Gravely, Bull. Mad Govt. Mus. (Nat Hist), V, No. 2, 1942, p. 52.

This species is also uncommon at Pamban, only a single, rather corroded and bleached shell from Pamban being represented in the original Museum collection, but a few more shells collected by Mr. Crichton have been subsequently added to the collection. The shell is moderate-sized, with a rhombus-shaped profile, a strongly elevated spire with the apex more sharply pointed than in the preceding species, and with the whorls strongly and angularly shouldered. There are four prominent, raised spiral ridges on the body whorl, of which the uppermost coincides with the angular shoulder. The ridges are ornamented with strong, sharply compressed, flattened, strongly raised and sometimes upwardly curved spinuous processes ; those on the uppermost ridge are the strongest, and those on the second slightly weaker, while those on the third and fourth are very small ; the interstices between the ridges are traversed by spiral rows of fine, close-set, scaly processes which render the surface somewhat rough and coarse-looking. The aperture is broad above and narrow below, its outer lip being strongly grooved within at positions corresponding to the external spiral ridges. The columella is smooth and feebly arched, and the umbilicus large and widely open. The shell is more or less uniformly pale brown externally, while the interior of the aperture is whitish. Pamban and Krusadai Island.

Thais tissoti (Petit).

Plate XVI, fig. 4.

Purpura tissoti, Petit, Journ. de Conchyl., III, 1852, p. 163, pl. vii, figs 4 *a* and *b*.
Purpura tissoti, Melvill & Abercrombie, Proc. Mem. Manchester Soc , VII, 1893, p. 31.
Purpura tissoti, Melvill & Standen, Journ de Conchyl., IX, 1898, p 43.
Thais tissoti, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist), V, No 2, 1942, p. 51.

This species, in which the shell is smaller than in the preceding species, is more abundantly represented in the Madras area than at Pamban, only two slightly worn Pamban shells being represented in Mr. Crichton's collection. The shell is ovate in profile and resembles in its general shape that of *Drupa margariticola*, but it is definitely broader and has a considerably wider aperture.

The whorls are shouldered, but much less strongly than in *T. rugosa*. On the body whorl there are four pronounced spiral ridges of which the uppermost is situated on the angular shoulder ; each of the strong ridges is really composed of two or more finer ridges and is conspicuously undulated, the elevated portions of successive ridges tending to form more or less indistinct, rounded, transpiral ribs. Of the four spiral ridges,

the first two are very strongly marked, while the remaining two are weaker but yet more raised than the fine ridges running in the interstices between the stronger ridges. The edge of the outer lip is finely crenulated within ; the columella is smooth and bears a thin callus deposit, and is traversed by a distinct white ridge travelling inwards at the posterior end of the aperture. The umbilicus is small and appears almost closed. The shell is pale ashy brown, transpirally banded with dark brown, while the strong spiral ridges are marked with alternate patches of white and bright yellowish brown. The interior of the aperture is whitish, edged with dark brown. Pamban.

Thais intermedia (Kiener).

Plate XVI, fig. 5.

Purpura intermedia, Kiener, Coq. Viv., VIII, 1836, *Purpura*, p. 51, pl 12, fig. 34.
Purpura intermedia, Reeve, Conch Icon , III, 1846, *Purpura*, pl. viii, fig. 38.
Thais intermedia, Crichton, Journ Bomb Nat. Hist. Soc., XLII, 1941, p 338
Thais intermedia, Gravely, Bull. Mad Govt Mus. (Nat. Hist), V, No 2, 1942, pp 49 and 52.

This species is comparatively rare at Pamban, and only a single dead shell, encrusted with branacles, from this locality, is represented in Mr. Crichton's collection, though living specimens have been recorded from Madras. The shell is moderately large, very thick and solid, with an extremely coarse and rough-looking surface, resembling that of *Drupa horrida* in general appearance, but it is readily distinguished by its much wider aperture and more strongly elevated spire. The processes on the surface are very large, widely spaced, in the form of coarse, conically pointed tubercles and are arranged in four spiral rows on the body whorl, those of the uppermost row being the largest and those of the lower rows successively smaller ; the interstices between the rows of tubercles are considerably reduced and are traversed by close-set spiral grooves. The columellar surface is fairly wide and bears a deposit of callus. The aperture is ovate, with a smooth, polished interior ; the outer lip is thick and provided with a row of strong, nodular teeth on the inside ; these nodules may sometimes be double, this condition being observed in a specimen from Trincomalee. The umbilicus is reduced and almost completely filled up. The tubercles are blackish, while the interstices are white ; the columella is whitish, blotched with brown. The inner surface of the outer lip is bluish white, heavily marked with patches of blackish brown at the margin. Pamban.

SERIES BUCCINACEA.

Family PYRENIDAE (= COLUMBELLIDAE).

The shell is usually small and spindle-shaped, with a more or less elevated spire and a narrow, somewhat elongated aperture. The surface is either smooth, striated or ribbed ; the outer lip is thick and often toothed inside. The anterior canal is very short and open ;

the umbilicus and posterior canal are absent. The tentacles and foot are large and very well developed.

A single genus, *Pyrene*, has been recorded, and is represented by six species.

Genus **Pyrene** (Bolten) Röding, 1798.

The shell is small, with a low, or more often, with an elevated, tower-shaped spire; the surface is either smooth or partly or completely spirally striated or ridged; the outer lip is usually thickened and toothed inside.

The Pamban species of *Pyrene* may be distinguished as follows :—

1. Transpiral ridges present on all the whorls of the spire and on the body whorl either throughout its entire surface, or at least confined to the upper portion of its surface	2
—Transpiral ridges absent; sculpture either altogether wanting, the surface being smooth, or, more usually, consisting of spiral grooves only	3
2. Shell minute, whitish, feebly dotted with brown, with strong, close-set, transpiral ribs; base of shell dark brown, and obliquely spirally grooved	*P. diminuta.*
—Shell much larger; spiral grooves confined to the base of the body whorl; shell yellowish white, sometimes dark grey, profusely mottled with brownish markings; transpiral ribs narrow, sharply raised and comparatively widely spaced	*P. zebra.*
3. Spire tall and slender, with numerous whorls, rather thin, whitish; whorls not inflated; body whorl angular below, spirally grooved at the base, and not markedly large in proportion to the spire ..	*P. mindorensis.*
—Spire shorter and broader at the base, with fewer whorls; shell thicker, with conspicuous brownish colour markings; whorls more or less convex; body whorl not appreciably angular below and relatively large in proportion to the spire	4
4. Shell rather narrow and elongately ovate, whorls of spire appearing as if slightly telescoped into each other owing to the sutures being depressly grooved;	

body whorl traversed by fine spiral ridges, complete towards the base, but incomplete, and well marked only towards the margin of the outer lip, in the upper part of the body whorl ; shell reddish or yellowish brown, with a spiral row of distantly spaced, large, white spots below the suture ; base of shell narrow ... . *P. flavida.*

— Shell smaller, broader and proportionately less elongate ; whorls not appearing telescoped, the sutures being normal and not channelled ; body whorl traversed by finer, more closely set spiral grooves only, often more well developed towards the base, the upper part of the surface of the body whorl being smooth or only faintly grooved ; shell whitish with irregular brownish markings in the form of spots or blotches ; base of shell comparatively broad ... 5.

5. Shell somewhat small, whorls more or less strongly angular a little below the suture ; the upper termination of the outer lip of the aperture being consequently strongly shouldered and well separated from the main body of the shell ; profile of outer edge of outer lip almost straight or even slightly concave, from the shoulder to the base ; aperture not much narrowed above ; shell whitish, marked with fine, dark brown, wavy lines or dots generally arranged in transpiral rows ; common . . .. *P. versicolor.*

— Shell considerably larger and proportionately broader, with more convexly inflated whorls which are evenly rounded and not angled above ; upper termination of outer lip rounded and closely approximated to and almost on a level with the general profile of the spire ; outline of the outer edge of outer lip more or less convexly rounded ; aperture much narrowed above ; shell whitish, with large, orange-brown markings which coalesce to form rounded islets of the ground colour, these islets being larger and fewer on the whorls of the spire and upper half of the body whorl, and smaller, more numerous and close-set in the lower part of the body whorl ... *P. vulpecula.*

Pyrene versicolor (Sowerby).

Plate XVI, fig. 6.

Columbella versicolor, Sowerby, Proc. Zool. Soc. London, 1832, p. 119.
Columbella versicolor, Sowerby, Thes. Conchyl., I, 1847, p. 117, pl 37, figs. 41-46.
Columbella bidentata, Sowerby, ibid., p. 118, pl 37, figs 33 and 54.
Columbella versicolor, Reeve, Conch Icon., XI, 1858, *Columbella*, pl xi, fig. 51.
Columbella bidentata, Reeve, ibid , pl. xxxii, fig. 205.
Columbella versicolor, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 330.

This is the commonest species of *Pyrene* represented at Krusadai, and has been recorded from all the usual collecting grounds in and around the Island, both live specimens sticking to dead coral on the reefs and dead shells washed up on the beach being abundant. The shell is small, broadly spindle-shaped with a moderately short spire and narrow, elongated aperture which is slightly flexed in the middle. The whorls are angularly shouldered a little below the suture ; the body whorl is traversed by fine, close-set spiral grooves which are strong and well marked towards the base, becoming weaker above and altogether obsolete above the shoulder. The outer lip is thick, straight and runs more or less parallel to the columellar border ; the upper end of the outer lip stands slightly out beyond the general level of the spire owing to the angulation of the body whorl at this part ; the inner surface of the outer lip is strongly denticulated. The columella lip is slightly arched and, in most Pamban specimens, bears two small, close-set teeth on its inner surface, this feature being the chief distinguishing one of the form *Columbella bidentata*, figured by Reeve and Sowerby as a separate species ; but Schepman includes them both under *C. versicolor*. The shell is white, marked all over with dark brown lines and dots ; these colour markings usually take the form of short, obliquely transpiral lines below the suture, followed immediately by a clear white zone and further down by a series of brown dots or spots arranged in somewhat irregular or wavy transpiral rows. In young shells, of which a considerable number are represented in the collection, the shell is thin, with fewer and paler markings, more strongly narrowed below, the whorls are not angled and the edge of the outer lip is curved, thin and smooth within. Pamban, Kundugal Point, Krusadai and Shingle Islands.

Pyrene zebra (Gray).

Plate XVI, fig. 7.

Columbella zebra, Gray, Sowerby's Thes. Conchyl , I, 1847, p. 127, pl 38, fig. 105.
Columbella zebra, Reeve, Conch Icon , XI, 1858, pl. xv, fig. 79.

Specimens of this species, though less abundant than those of the preceding, live in fairly large numbers on the reefs in company with shells of *P. versicolor*, and numerous dead shells are also commonly thrown up on the beach. The shell is narrower and more elongate with a more strongly elevated and sharply pointed spire. The whorls are not angularly shouldered near the suture. The surface of the shell bears strong, raised, somewhat widely

separated transpiral ribs on the body whorl ; these ribs are strongest above, becoming weaker downwards and eventually disappearing altogether towards the base, where, however, they are replaced by fine, obliquely spiral grooves ; the transpiral ribs, however, are well developed throughout the surface on the whorls of the spire. The aperture is slightly broader than in *P. versicolor*, but comparatively narrow posteriorly ; the outer lip is less strongly thickened and not widely separated from the columellar border posteriorly ; the edge of the outer lip is finely toothed inside. The general ground colour of the shell is pale yellowish brown (the ribs being usually conspicuously whitish), but there are bright, irregular, dark brown or chestnut markings in the form of small, broken, zig-zag lines or dots arranged in longitudinal rows which give the shell a markedly striped appearance ; some specimens have a dark greyish blue ground colour, but this is probably acquired. A few Pamban shells formerly named *P. terpsichore* have been later re-identified as *P. zebra* by Mr. Winckworth. Pamban, Krusadai and Shingle Islands.

Shells of this and the preceding species are extensively employed for making ornamental necklaces which are commonly sold in the temple at Rameswaram.

Pyrene flavida (Lamarck).

Plate XVI, fig. 8.

Buccinum flavum, Bruguière, Encyclopédie, Méthodique, Vers, 1789, p. 281.
Columbella flavida, Lamarck, Anim. sans vert , VII, 1822, p. 294.
Columbella flavida, Sowerby, Thes. Conchyl , I, 1847, *Columbella*, p 118, pl. 27, figs. 55-57.
Columbella flava, Reeve, Conch Icon , XI, 1858, *Columbella*, pl vi, figs 27 and 28.
Columbella (*Conidea*) *flava*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 337.

This species is much less common than the preceding ones and is represented in the collection only by dead shells The shell is considerably larger and proportionately more elongately spindle-shaped ; the surface is often covered by a horny skin, but in shells from which this has been removed, the surface presents a smooth and glossy appearance The whorls are slightly inflated and evenly rounded, being entirely devoid of angular shoulders. The sutures are slightly depressed. The whorls of the spire are smooth throughout, but the surface of the body whorl is traversed by fine spiral ridges which are entire towards the base, but incomplete and present only on a small portion of the surface adjoining the edge of the outer lip in the upper part of the body whorl. The aperture is moderately broad, but rather strongly narrowed at the posterior extremity The columella bears a thin deposit of callus and the outer lip is slightly thickened and denticulated within. The shell is deep yellowish or reddish brown marked with a spiral row of a few widely spaced, large, white spots immediately below the suture ; this is the type figured by Reeve in figs. 28*a* and *b*, and the majority of the shells in the collection conform to this pattern ; but a few faded shells are whitish, traversed by fine, longitudinal, flexuous, brownish lines, approaching figs 27*a* and *b* of Reeve. The columella and interior of aperture are whitish. Pamban and Krusadai Island.

Pyrene vulpecula (Sowerby).

Plate XVI, fig. 9.

Columbella vulpecula, Sowerby, Thes. Conchyl , I, 1847, pl. 38, fig 90.
Columbella vulpecula, Reeve, Conch. Icon , XI, 1858, *Columbella*, pl xvi, fig. 80
Pyrene vulpecula, Gravely, Bull. Mad. Govt. Mus. (Nat Hist), V, No. 2, 1942, p. 53.

This species is even scarcer than the preceding one and was not recorded from Pamban until very recently. The shell is thick, and about the same size as *P. flava*, though considerably broader and more widely ovate. The whorls are evenly rounded and the sutures are normally developed, not depressed as in *P. flavida*. The spire is comparatively short, but with a wider base. The profile of the shell presents a very even, spindle-shaped appearance. The base of the shell is broader than in the preceding species. The surface is smooth and even slightly glossy for the most part, but the body whorl is finely and closely spirally grooved towards the base. The aperture is much narrowed posteriorly and the columella is slightly arched ; the outer lip is thickened and finely toothed within. The shell is white with bright, orange-brown markings disposed more or less in the form of a network enclosing rounded patches of the ground colour which are small and numerous on the lower half of the body whorl, but large and few on its upper part and the spire. Krusadai Island.

Pyrene diminuta (Adams).

Columbella diminuta, C. B. Adams, Catalogue of the Shells of Panama, 1852, p. 85.
Columbella diminuta, Reeve, Conch Icon , XI, 1858, *Columbella*, pl. xx, fig. 115.

A single, minute, half-worn shell from Pamban, which had been previously identified as *P. pusilla*, was, on closer examination, found to approach Reeve's figure and description of *P. diminuta* far more closely, and has therefore been provisionally assigned to this species. The shell is very small, scarcely exceeding 5 mm. in length, and rather narrowly spindle-shaped. The whorls bear comparatively strong, broadly rounded transpiral ribs which are slightly nodularly swollen at the sutures ; on the body whorl, these ribs disappear towards the basal portion, where they are replaced by fine spiral grooves. The aperture is reduced to a narrow slit and the outer lip is smooth within. The shell is whitish brown, banded with dark brown towards the base. Pamban.

Pyrene mindorensis (Gaskoin).[1]

Columbella mindorensis, Reeve, Conch. Icon , XI, 1859, *Columbella*, pl. xxx, fig. 193.

This species is uncommon and represented in the collection only by two shells from Pamban. The shell is very different from those of the preceding species and approaches more a small *Cerithium* in shape. It is readily distinguished by its comparatively tall and slender spire with numerous whorls, and the body whorl being much smaller in proportion to the spire than in the foregoing species. The body whorl is strongly angular about the

[1] Gaskoin's is a manuscript name. The name was first published by Reeve in his monograph cited above.

middle, and markedly narrowed towards the base; the surface of the shell is smooth and glossy for the most part, but finely obliquely grooved at the narrow basal part. The aperture is small and elliptical instead of being an elongated, narrow slit as is usual in the genus. The outer lip is slightly thickened and feebly toothed within. The shell is translucent whitish, but the present specimens appear much faded and devoid of any colour markings; in the middle of the body whorl, however, there is a spiral row of distinct, opaque white spots; a few such spots are seen also on one or two of the lower whorls of the spire just above the suture. Pamban.

Family BUCCINIDAE.

The shell is generally ovately conical, sometimes spindle-shaped, smooth or sculptured and usually covered with a thick horny or hairy periostracum when fresh. The columella is usually smooth, sometimes wrinkled, but without definite spiral folds. The operculum is horny and generally terminally nucleated The foot is large and the eyes are situated at the base of the tentacles. Shells commonly known as whelks are included in this family.

The Krusadai species of Buccinidae belong to three genera, which may be distinguished as follows :—

1. Shell as a rule not large, more or less broadly spindle-shaped, with spiral sculpture, and sometimes also with transpiral ribs; either uniformly coloured or with dark-coloured spiral bands; aperture rather small and narrow, with an apical notch bounded by ridges on *both sides*; columella generally wrinkled. 2.

— Shell as a rule larger, ovoid and with more or less inflated body whorl, without either spiral or transpiral sculpture, smooth and even somewhat glossy, with a characteristic pattern of large brownish patches on a white ground; aperture large, ovate, and with an apical notch bounded by a ridge on *the inner side only*; columella and inside of outer lip smooth ... *Babylonia.*

2. Shell small, usually with conspicuous coloured spiral bands; aperture small, but with well developed apical notch which is large in proportion to the size of the shell; spiral sculpture rather poorly developed. *Engina.*

— Shell somewhat larger, more or less uniformly brownish or dark-coloured, without conspicuous colour bands; aperture relatively large, and notch at

apex of aperture, when present, much reduced and small in proportion to the size of the shell, spiral sculpture strongly developed in the form of ridges . *Cantharus.*

Genus **Engina** Gray, 1839.

The shell is small, ovately spindle-shaped, usually thick-walled, with conical spire and more or less strong spiral striae and transpiral ribs ; the aperture is small, with the outer lip thickened and strongly toothed within.

Two species, *E. zonata* and *E. trifasciata* have been recorded, but neither of them is known from the Madras area. The Pamban specimens labelled *E. melanozoa* Tomlin, in Mr. Critchton's collection were, on scrutiny, found to belong to *E. zonata.*

E. trifasciata is readily distinguished from *E zonata* by the shell being smaller with strongly shouldered whorls, the transpiral ribs being stouter and more strongly developed, and by the coloured spiral bands being reddish brown instead of blackish.

Engina zonata (Reeve)

Plate XVI, fig. 10.

Ricinula zonata, Reeve, Conch Icon., III, 1856, *Ricinula*, pl v, fig 33.
Ricinula zonata, Tryon, Man. Conch , V, 1889, p. 194, pl 63, fig. 52
Engina zonata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 308

This is much commoner than the next species, and is frequently found represented in large numbers on the reefs, often living in company with specimens of *Pyrene versicolor*, particularly on Galaxea reef on the south side of Krusadai Island. The shell is small and easily recognized by its characteristic spindle-shape, and by the presence of bold, dark-coloured spiral bands encircling it on the surface The whorls are scarcely shouldered, but the shell bears broadly rounded transpiral ribs which, however, are sometimes imperfectly developed and are often well marked only on the body whorl. In addition to the transpiral ribs, there are very fine, close-set, spiral striae traversing the entire surface, and a double spiral row of compressed, transversely elongate tubercles is enclosed by the zone covered by each coloured spiral band. The aperture is narrow, elongate and slightly broader posteriorly, its entire margin including the columellar border and the inside of the outer lip being finely denticulated The apical notch is relatively large and well defined, being bordered by a ridge on either side. The anterior canal is short and open The shell is yellowish white, the blackish or blackish green spiral bands standing out conspicuously on the pale ground Krusadai and Shingle Islands.

Engina trifasciata (Reeve).

Plate XVI, fig. 11.

Ricinula trifasciata, Reeve, Conch. Icon, III, 1856, *Ricinula*, pl v, fig. 41.
Ricinula alveolata, var, Tryon, Man Conch., V, 1889, p 189, pl 61, fig. 20.
Engina trifasciata, Schepman, Siboga-Expeditie, Prosobarnchia, Monogr. XLIX, 1908, p. 308.

The shell resembles closely that of the preceding species in its pattern of colouration, but is readily distinguished from it by its more strongly narrowed base and by the more pronounced development of the transpiral ribs ; the shell is slightly smaller and on the whole more strongly sculptured than in *E. zonata* The whorls are somewhat markedly shouldered. The transpiral ribs are strongly raised and separated by deep interstices, while the spiral ridges are strong, narrow, raised and close-set, those in the zones enclosed by the coloured spiral bands being particularly well marked, and often swollen into nodules where they cross the transpiral ribs, there being only one such spiral ridge to each dark band. The aperture is broader than in *E. zonata*, the outer lip being thinner and its inner surface and columella being relatively smooth. The anterior canal is slightly produced, rendering the base of the shell narrow. The shell is whitish, marked by bright reddish brown spiral bands, the middle three of which are broader and more conspicuous than the rest (hence the name *trifasciata*). This species is much less common than the preceding one and only dead shells are represented in the collection Pamban.

Genus **Babylonia** F. Schluter, 1838.

(Syns. **Eburna** Lamarck, 1822 ; **Latrunculus** Gray, 1847).

The shell is thick, usually large, with a well marked periostracum, white, with large brownish patches and with the umbilicus either closed or open. The surface is smooth, the spire well elevated and conical and the whorls inflated The columella is smooth and bears a deposit of callus The foot is thick, elongated and obtusely pointed behind, and the tentacles moderately long.

A single species is recorded.

Babylonia spirata (Linné).

Plate XVI, fig. 12.

Buccinum spiratum, Linné, Syst. Nat, Ed X, 1758, p 753
Eburna spirata, Lamarck, Anim. sans vert, (Deshayes' edit), X, 1845, p. 233.
Eburna spirata, Reeve, Conch Icon, V, 1849, *Eburna*, pl 1, fig 7
Eburna spirata, Hornell, Common Mollusc of South India, Mad. Fish Bull., XIV, 1921, p. 133.
Babylonia spirata, Gravely, Bull Mad Govt Mus. (Nat Hist.), V, No. 2, 1942, p. 55.

This species is common at Madras, but relatively rare at Pamban, whence only a few dead shells have yet been collected, particularly on the mud flats at Kudugal Point. The shell is smooth, ovoid, and covered, when fresh, by a strong, brownish periostracum. The

whorls are inflated and the sutures are sunk in broad, inwardly sloping grooves. The columella is smooth and somewhat strongly thickened with callus ; the umbilicus is almost completely filled up by callus. The aperture is large, ovate, and constricted posteriorly by a single, thick ridge extending spirally inwards on the columellar side. The anterior canal is represented by an oblique notch at the base of the aperture. The inside of the outer lip is smooth and unthickened. The shell bears a very characteristic colour pattern consisting of regular spiral rows of large, rounded or squarish, brownish or orange-brown patches on a white ground ; the apex of the aperture is tinged blackish. Kundugal Point.

Genus **Cantharus** (Bolten) Röding, 1798.

The shell is more or less broadly spindle-shaped, as a rule with strong ribs and weaker spiral ridges ; often with a thick periostracum which may be frequently hairy. The aperture is ovate, its columellar border arched and the outer lip more or less thickened and grooved within.

This genus is represented by a single species belonging to the section *Pollia* Sowerby, 1834 (of which *Tritonidea* Swainson, 1840, is a synonym).[1]

Cantharus undosus (Linné).

Plate XVI, figs. 13*a* and 13*b*.

Buccinum undosum, Linné, Syst. Nat., Ed. X, 1758, p. 740, No. 409.
Buccinum undosum, Kiener, Coq. Viv., IX, 1834, *Buccinum*, p 39, pl 12, fig 41, pars
Buccinum undosum, Reeve, Conch. Icon., III, 1846, *Buccinum*, pl. viii, fig 55.
Tritonidea undosa, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 302.

This species is fairly common at Krusadai, large numbers of specimens being frequently found alive on the reefs, attached to blocks of dead coral. The shell is moderately small, but much larger than that of *Engina*, thick and spindle-shaped. The surface is traversed throughout by uniformly developed, strong, close-set spiral ribs The shell is covered when fresh, with a thick periostracum which is finely but conspicuously hairy all over and which persists in the interestices between the spiral ribs even in shells which have been subjected to considerable wearing. The anterior canal is broadly open and slightly inclined. The columellar border is concavely excavated and bears a few irregular ridges anteriorly. The outer lip is thickened and strongly dentated within at the edge, the teeth merging into fine ridges interiorly. The aperture is ovate and its apex constricted into a small but well defined notch by a ridge on either side. The presence of the periostracum renders the shell dull greenish brown, but when it is completely scraped away, the spiral ribs appear bright reddish brown on a pale, bluish white ground. Krusadai and Shingle Islands.

[1] It is probable that *Cantharus melanostoma* Reeve, a species recorded from Madras and Tuticorin, and distinguished by its fairly large, thick, yellowish brown shell with spiral ridges and broadly rounded transpiral ribs, should also occur at Pamban, but as yet no specimen has been collected from this locality.

Family VOLEMIDAE (= GALEODIDAE)

The shell is large, massive and pear-shaped, very much like that of a sacred chank in shape and proportions, but the columella is entirely devoid of folds in this family. The whorls are strongly shouldered and this angular part is beset with pointed tubercules. The aperture is elongated and the operculum terminally nucleated. The foot is large and the proboscis elongated.

A single genus, *Hemifusus*, is recorded from Pamban.

Genus **Hemifusus** Swainson, 1840.

The shell is large with a periostracum, spindle-shaped, with a moderately elevated spire and with a somewhat elongated anterior canal.

Two species, *H. pugilinus* and *H cochlidium* are represented at Pamban. In the former, which is by far the commoner, the tubercles on the shoulders are more numerous and close-set but less strongly developed, and the sutures are simple, while in the latter, the shell is as a rule larger and more massive, the tubercles on the shoulders are considerably larger and sharper, but fewer and more widely separated and the sutures are sharply and deeply excavated.

Hemifusus pugilinus (Born).

Plate XVI, figs. 14*a* to 14*c*.

Murex pugilinus, Born, Test Mus Vindob., 1778, p. 314.
Murex vespertilio, Gmelin, Syst Nat, Ed. XIII, 1791, p. 3553.
Pyrula pugilina, Deshayes in Lamarck, Anim sans vert., Ed. II, Vol. IX, 1844, p 508 (foot-note).
Pyrula pugilina, Reeve, Conch. Icon, IV, 1874, *Pyrula*, pl 1, fig. 1.
Pyrula pugilina, Sowerby, Thes. Conchyl, IV, 1880, p. 101, pl 419, figs. 11 and 12.
Hemifusus (Pugilina) pugilinus, von Martens, Journ. Linn Soc, Zool., XXI, 1887, p 180.
Volema pugilina, Crichton, Journ. Bomb Nat Hist. Soc, XLII, 1941, p 334.
Hemifusus pugilinus, Gravely, Bull. Mad Govt Mus (Nat. Hist), V, No 2, 1942, p 57.

This species which is represented also in the Madras area, is moderately common at Krusadai, and both dead shells and live specimens have been collected from this area. The shell is thick, fairly large and more or less pear-shaped. The surface of the lower half of the body whorl bears distinct, close-set spiral ridges, while the remaining portion of the surface of the body whorl is relatively smooth. The whorls of the spire are spirally ridged. In each whorl there is a strong angular shoulder bearing a row of stout, compressed tubercles. The aperture is elongated, the anterior canal broadly open and the columella devoid of folds. The shell is externally uniformly dark reddish brown, but may be dark horny brown when fresh owing to the presence of a fairly thick periostracum. The interior of the aperture is brownish yellow. The operculum is thick, horny, ovate and with a terminal nucleus.

A young shell of this species from Krusadai Island is represented in the collection ; it is pale brown, with the surface uniformly encircled throughout with strong, well-developed spiral ridges separated by deep interstices, the ridges on the lower part of the body whorl running obliquely. The whorls are not conspicuously shouldered. Pamban, Krusadai and Shingle Islands.

Hemifusus cochlidium (Linné).

Plate XVII, figs. 1*a* and 1*b*.

Murex cochlidium, Linné, Syst. Nat, Ed X, 1758, p. 753.
Pyrula cochlidium, Lamarck, Encyclopédie Méthodique Vers, 1816, pl. 434, Liste, p. 8.
Pyrula cochlidium, Reeve, Conch. Icon., IV, 1847, *Pyrula*, pl 1, fig 2

A single spirit-preserved specimen, with the foot and operculum intact, is represented in the collection. The shell is large, very thick and solid and resembles the preceding in shape and general appearance. The surface of the shell is covered with a thick, greyish brown epidermis, and, in the specimen examined, it is also encrusted with a few small solitary corals (*Trochocyathus*). The spire in the present specimen is shorter and broader than indicated by Reeve's figure of this species. The whorls are strongly angularly shouldered, and the shoulders bear very strongly developed tubercles which, particularly on the body whorl, are much fewer and more widely separated than in the preceding species ; the tubercles are antero-posteriorly compressed and more or less angular. The whorls of the spire are sculptured with fine, but well raised spiral ridges, while the body whorl is relatively smooth, its sculpture being reduced to a mere, feebly developed, spiral grooving. The sutures are peculiar in being strongly sunk in deep, narrow grooves. The aperture is elongated and roughly rectangular in profile, with the columellar border slightly concavely arched ; the anterior canal is moderately elongate, but more widely open than in the preceding species. The operculum is elongately ovate, with a terminal nucleus. The umbilicus is almost closed. The outer surface is dark reddish brown, while the columella and interior of the aperture are pale yellowish brown. Rameswaram.

Family NASSIDAE.

The shell is usually small or moderately large, with the spire elevated to a varying extent ; the surface is either smooth or more often sculptured, and usually bears a delicate gloss. The anterior canal is very short and the columella is often provided with a thick callus deposit which is sometimes widely spread out. The operculum is horny and often serrated at the edge. The foot is large, often with two posterior appendages.

This family is represented at Pamban by two genera, *Nassa* and *Bullia*. In *Nassa*, the shell is somewhat broad and moderately short, with a spire which is at most as high as the body whorl, but often considerably shorter, and with a well-defined anterior canal whose outer side is usually bounded by a fold in the margin of the outer lip of the aperture ; the columella is often provided with a thick callus or a strong ridge at the upper part or both. In *Bullia*, on the other hand, the spire is slender and fairly strongly elongated, with numerous whorls, and the anterior canal is widely open, not being bounded by any fold on the outer side ; the columella is devoid of a tooth and the callus is very thin, often absent

Genus **Bullia** Griffith, 1834.

The shell is of variable size, elongately ovate, with a tall, tower-shaped spire, smooth or sculptured with spiral grooves or ribs ; the aperture is more or less large, widely sinuated below, without well, defined canal. The columella is concave.

A single species has been recorded from Pamban

Bullia melanoides (Deshayes).

Plate XVII, figs. 2*a* and 2*b*.

Buccinum melanoides, Deshayes, in Belanger Voy. Ind. Orient, VI, 1832, p 430, pl 11, figs. 3 and 4.
Bullia turrita, Gray, Zool Beechey's Voy , 1839, p. 126.
Bullia malabarica, 'Hanley', is a MS name type in Brit Mus.
Bullia (Pseudostrombus) malabarica, Melvill & Standen, Proc Zool Soc London, 1901, pt. 2, p 408

This species is fairly well represented at Pamban, and both dead shells and living specimens have been collected The latter are often found borrowing rapidly in the soft sand along the shore line with the aid of their powerful, broadly expanded foot ; they are particularly common on the shore extending from the Kundugal Point and facing Krusadai Island, and are also sometimes found in large numbers all along the shore of Rameswaram Island ; numerous living specimens have been collected also from the Dhanushkodi coast. Fresh shells have a slightly glossy lustre and are purplish black in colour, but worn and empty ones are usually much paler, and more or less bleached white. The surface of the shell is traversed by transpiral ridges and fine, spiral grooves which closely decussate with the former, forming a more or less distinct latticed sculpture, specially well marked in the upper whorls of the spire, but usually absent from the middle portion of the body whorl and sometimes also from that of the next whorl above. On the body whorl there are as a rule a group of four or five spiral grooves at the base, and on this and the next whorl, a single groove immediately below the suture, and below it two rather close-set grooves somewhat widely separated from it, the remaining intervening space being nearly smooth, and the transpiral ribs are mostly confined to the uppermost part in these whorls ; in young specimens, however, the transpiral ribs and the spiral grooves extend throughout the surface. The shell is moderate-sized,

with a tall, somewhat slender spire and slightly inflated whorls. The aperture is comparatively small with a widely open notch below, representing the anterior canal. The outer lip is thin and smooth within. The shell is of a dark purplish grey colour with a whitish or pale brownish, glossy apex. Rameswaram, Kundugal Point and Pamban.

Genus **Nassa** (Martini, 1774 part) Lamarck, 1799.

(Syn. **Nassarius** Froriep, 1806.)

The shell is almost always without an umbilicus, ovately conical, smooth, or with variable sculpture ; the aperture is as a rule ovate, with a short anterior canal, a thickened outer lip and a concave columella, which is not uncommonly thickened with callus.

The Pamban species of *Nassa* may be distinguished with the aid of the following key :—

1. All the whorls of the shell provided with strong, transpiral ribs which are more or less uniformly well developed throughout the surface ; fine spiral grooves present, and usually confined to the base and upper part of the body whorl ... ... 3.

— Transpiral ribs absent, except in the uppermost whorls of the spire ; body whorl and lower part of the spire devoid of transpiral ribs, though the uppermost parts of the whorls may sometimes be nodular, and body whorl and lower whorls of the spire traversed by fine spiral grooves or impressed spiral lines, either throughout, or only near the base and suture ... ... 2.

2. Shell rather large, ornamented throughout with somewhat widely but regularly spaced, fine, orange-red, thread-like spiral lines ; uppermost part of each whorl strongly cut up into a spiral row of rounded nodules, abutting against the suture immediately above ... ... *N. suturalis.*

— Shell smaller, more or less glossy, surface of body whorl traversed by very fine close-set spiral grooves only, which are mostly confined to the basal and upper portions, the middle part of the surface being almost smooth ; coloured spiral lines absent ; uppermost part of each whorl normal, not nodular ... ... *N. pallidula.*

3. Transpiral ribs somewhat widely spaced and absent from the greater part of the outer half of the surface of the body whorl, this part being either entirely smooth, or with a spiral row of nodules immediately below the suture ; the edge of the outer lip of aperture thickened into a strongly raised ridge on the outside. 4.

— Transpiral ribs close-set and extending throughout the entire surface of the body whorl ; edge of the outer lip of aperture not particularly thickened into a ridge-like elevation on the outside ... ... 5.

4. Shell somewhat larger ; apertural surface flattened, with an enormous, whitish, polished, overspreading callus deposit, which hides the entire body whorl and lower part of the spire from view when the shell is observed from the side of the aperture ; the thickening of the outer lip more or less a continuation of this callus ; body whorl rather humped in the middle ... *N. thersites.*

— Shell smaller and proportionately narrower ; apertural surface not flattened ; columella without marked callus thickening as in the above, and consequently body whorl and spire fully exposed in a view from the apertural side ; body whorl much less inflated and not conspicuously humped about the middle ; much commoner . ... *N. jacksoniana.*

5. Spiral grooves uniformly developed throughout the surface of the shell, the one immediately below the suture being deeper and more pronounced than the rest, and forming a more or less well-defined fillet between it and the suture ... ... *N. costata.*

— Spiral grooves absent from the middle part of the surface of the body whorl, between the single deep one immediately below the suture and the usual group of four or five close-set ones at the base ; whorls of spire with only a single spiral groove below the suture. *N. hepatica.*

Nassa jacksoniana (Quoy and Gaimard).

Plate XVII, figs. 3*a* and 3*b*.

Buccinum jacksonianum, Quoy and Gaimard, Zool. Voy. de L' Astrolabe, II, 1833, p 452, pl. 32, figs. 28 and 29.
Buccinum polygonatum var, Kiener, Spec. Gen. *Buccinum*, 1841, p. 92, fig 107.
Nassa jacksoniana, Tryon, Man Conch, IV, 1882, p. 29, wrongly included as var of *N. monile*
Nassa siva, Preston, Journ. Malac., XI, 1904, p. 76, pl. vi, figs 3 and 4.
Nassa jacksoniana, Jose Giner Mari, Journ de Conchyl, LXXVIII, 1934, p 62
Nassa jacksoniana, Gravely, Bull. Mad. Govt Mus. (Nat. Hist), V, No. 2, 1942, pp. 60 and 62.

This is probably the commonest species of *Nassa* collected from the Krusadai Island area. Living specimens are sometimes found abundantly in certain areas on the mud flats at Kundugal Point, and at Watchman's Bay on Krusadai Island. The shell is rather small and ovately conical. The surface is sculptured with strong, sharply raised transpiral ridges which are separated by wide interstices, and which are present throughout, except on the outer half of the body whorl, where, however, their vestiges are represented by a row of mere, rounded nodules immediately below the suture, the rest of the surface below these nodules being practically smooth and even slightly glossy. The edge of the outer lip of the aperture is thickened into a ridge on the outside, and distinctly toothed within Two or three fine, impressed spiral lines are present at the base of the body whorl. The columella is concavely arched and almost entirely devoid of callus thickening. The shell is of a pale olive green ground colour on which the whitish or yellowish white transpiral ribs stand out prominently, the middle of the body whorl is often marked by a rather indistinct purplish brown spiral band. Pamban, Kundugal Point and Krusadai Island.

Nassa hepatica (Montagu).

Plate XVII, fig. 4.

Buccinum hepaticum, Montagu, Test Brit, 1803, p. 243
Buccinum monile, Kiener, Coq. Viv., IX, 1834, p. 68, pl xi, fig 40.
Nassa monile, Reeve, Conch Icon, VIII, 1853, *Nassa*, pl. vi, fig. 38.
Nassa lachrymosa, Reeve, ibid., pl viii, fig. 52
Nassa hepatica, Gravely, Bull Mad. Govt. Mus. (Nat. Hist), V, No 2, 1942, p. 61.

This species is considerably scarcer than the preceding, but both dead shells and live specimens have been collected from the Pamban area, the latter being usually found in company with those of *N. jacksoniana*. The shell is larger, and bears a well elevated spire with a sharp apex. The entire surface is traversed by strong transpiral ribs which tend to be slightly flexuous on the body whorl ; the whorls bear a single strong spiral groove immediately below the suture cutting across the transpiral ribs at this part and thus giving rise to a series of nodules between it and the suture above ; on the body whorl, however, there is a group of about four close-set spiral grooves at the base in addition to the single one above near the suture, the intervening portion of the surface between this and the basal group of grooves being entirely devoid of spiral grooves. The aperture is fairly broad and

is constricted posteriorly by a ridge on the inner side. The columellar border is deeply arched and covered with a thin layer of callus, the surface of which is feebly ridged. The shell is pale olive green, tinged with light brown, but the transpiral ribs are often paler than the interstices, and sometimes almost whitish. The interior of the aperture is blackish brown, marked with two conspicuous white spiral bands, thus strongly recalling the external colour pattern of *Cypraea asellus*. Pamban and Kundugal Point.

Nassa costata Adams.

Plate XVII, fig 5.

Nassa costata, A Adams, Proc. Zool Soc London, XIX, 1851, p. 98.
Nassa costata, Reeve, Conch. Icon , VIII, 1853, *Nassa*, pl. xxi, fig 142.
Nassa costata, Gravely, Bull. Mad. Govt Mus (Nat. Hist.), V, No. 2, 1942, p. 61.

This species is much less common than the two preceding ones, though a fairly good number of dead shells and specimens collected alive from Krusadai are represented in the collection. The shell very closely resembles that of *N. hepatica*, but is readily distinguished from it by the spiral grooves being present throughout the surface of the shell, though the one immediately below the suture is deeper and more pronounced as in that species, cutting up the transpiral ribs into a series of nodules between them and the suture. The remaining spiral grooves are fine and thread-like. The shell is slightly narrower with a proportionately more strongly elevated spire ; the transpiral ribs are finer, more close-set and less strongly flexuous in the middle. The outer surface is pale greenish grey and sometimes marked with indistinct dark brown spiral bands ; some of the interstices between the ribs are often blotched with rusty brown. The columella is covered with a thin layer of callus. The interior of the aperture is whitish, banded with purplish brown. Kundugal Point and Krusadai Island.

Nassa thersites (Bruguière).

Plate XVII, figs. 6*a* and 6*b*.

Buccinum thersites, Bruguière, Encyclopédie Méthodique, Vers, 1816, pl. 394, fig. 8
Buccinum thersites, Kiener, Coq. Viv., IX, 1834, p 87, pl 28, fig 112
Nassa thersites, Reeve, Conch. Icon , VIII, 1855, *Nassa*, pl. x, fig. 65
Nassa (*Arcularia*) *thersites*, Schepman, Siboga-Expeditie, Monogr XLIX, 1908, p. 312.
Arcularia thersites, Hornell, Common Molluscs of South India, Mad Fish Bull., XIV, 1921, p. 134.

This species is moderately common in the Pamban area, and living specimens have been collected particularly on the mud flats at Kundugal Point, and on the sandy stretches at Watchman's Bay and Bushy Point on Krusadai Island. The shell is at once distinguished from those of the remaining Pamban species by its strongly flattened, polished callosity on the columella, widely spread out and so extensive as to reduce the size of the aperture considerably and conceal from view the entire body whorl and part of the spire on the apertural

side. The shell is rather thick, with a short spire and somewhat large, inflated body whorl which is elevated and peculiarly raised into a knob-like prominence in the middle on the side away from the aperture. The outer half of the external surface of the body whorl is almost smooth, except for a few faint oblique striae ; but the inner half of its surface (i.e., the part adjoining the columellar border) and the entire surface of the whorls of the spire are traversed by strong obliquely transpiral ribs. The margin of the outer lip is reflected and thickened and its inner edge toothed. The shell is ashy green with a dark central spot on the surface of the body whorl. Pamban, Kundugal Point, Krusadai and Shingle Islands

Nassa suturalis (Lamarck).

Plate XVII, figs. 7*a* and 7*b*.

Buccinum suturale, Lamarck, Anim. sans vert (Deshayes' edit.), X, 1845, p. 166.
Nassa suturalis, Reeve, Conch Icon., VIII, 1855, *Nassa*, pl 1, figs 4 and 11.

This species has not been collected alive at Pamban, and is represented in the collection only by a few dead shells. The shell is moderately large, with a more strongly elevated spire than in the preceding species. The greater part of the surface of the body whorl and the next whorl above it are practically smooth, but the upper whorls of the spire are sculptured with strong transpiral ribs. The surface of the shell presents over its greater part a delicate gloss and is traversed throughout by fine, orange-red, evenly-spaced, impressed spiral lines. Immediately below the suture, however, there is a spiral row of strong, rounded nodules in each whorl, those on the body whorl being the largest. The columellar callus is thin and smooth, but bears a strong, ridge-like tooth above The aperture is ovate and is constricted into a deep notch at its apex. The inner surface of the margin of the outer lip bears numerous close-set teeth. The shell is whitish, with very pale, brownish markings scattered all over, in addition to the fine reddish spiral lines mentioned above. Pamban.

A specimen from Krusadai Island approaches the above description closely in the presence of fine, thread-like, reddish brown spiral lines and pale brown, diffuse markings, but differs in having a proportionately shorter spire and the sutural nodules being much less strongly developed. It is presumably a variety of *N. suturalis* and corresponds more or less closely to the one figured by Reeve on plate ii of his Monograph on *Nassa* (fig. 11).

Nassa pallidula Adams.

Plate XVII, fig. 8.

Nassa pallidula, A Adams, Proc Zool Soc. London, XIX, 1851, p 106
Nassa pallidula, Reeve, Conch Icon., VIII, 1855, *Nassa*, pl. xvi, fig. 108.

This species is rare at Pamban and represented by a single dead shell from this locality in Mr. Crichtons' collection. The shell is rather small and broadly ovate, with a moderately

elevated, pointed spire and inflated body whorl. The surface of the shell is almost entirely (except a small part about the middle of the body whorl) traversed by fine, evenly spaced spiral grooves which are intersected in the upper whorls of the spire by strongly developed, close-set transpiral ribs, thus giving rise to a more or less closely reticulated sculpture on this part of the surface. The columella is covered by a somewhat strongly marked deposit of callus, deeply arched and provided with a strong tooth above and a few, feebly developed, oblique ridges below. The outer lip is much thickened and strongly ridged within. The shell is pale yellowish brown, tinged with darker brown near the sutures and the base. Pamban.

Family FASCIOLARIIDAE.

The shell is elongated and more or less spindle-shaped and often with a long, narrow anterior canal. The spire is usually tall, its height generally varying in direct proportion to the length of the anterior canal. The columella is often smooth, but when folds are present, they are few and feebly developed. The operculum is horny, with a terminal nucleus. This family includes the shells commonly known as spindle shells and knobed chanks.

Two genera, *Fusinus* and *Fasciolaria*, are represented at Pamban, each by two species. The genus *Fasciolaria* is easily distinguished from *Fusinus* by its thicker and more solid shell, by the deeper and more brilliant colouration of the shell and by the columella being almost always traversed by a few oblique folds at the base.

Genus **Fasciolaria** Lamarck, 1801.

The shell is without an umbilicus, usually large, spindle-shaped, with a more or less strongly elevated spire. The aperture is usually elliptical, with a more or less open, elongated anterior canal. The margin of the outer lip is sharp. The columella is twisted and as a rule bears three oblique folds.

Two species, *F. filamentosa* and *F. trapezium* are recorded; of these the former is much the commoner, and is readily distinguished by its very feebly angulated and almost evenly rounded whorls and by the tubercles on the shouldered part of the whorls being much less strongly developed.

Fasciolaria filamentosa Lamarck.

Plate XVII, figs. 9*a* to 9*c*.

Fasciolaria filamentosa, Lamarck, Anim. sans vert., (Deshayes' edit.), IX, 1840, p. 434.
Fasciolaria filamentosa, Kiener, Coq. Viv., VI, 1840, *Fasciolaria*, p. 11, pl 8, fig. 1.
Fasciolaria filamentosa, Reeve, Conch. Icon , IV, 1847, *Fasciolaria*, pl. 11, fig. 4.
Fasciolaria filamentosa, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 294.

This species is moderately common at Pamban, and both dead shells and live specimens have been collected. The shell is fairly large, thick, massive and spindle-shaped, with a well

developed, strongly elevated spire and a moderately elongated anterior canal. The surface of the shell is traversed throughout by shallow spiral grooves which occur in pairs and become increasingly oblique towards the lower end of the anterior canal. The whorls are very feebly angulated, the shoulders being almost obsolete and bearing poorly developed, broad, rounded tubercles which are often rudimentary or absent. The columella is strongly arched, smooth above, but bears three weak, oblique folds towards the base. The aperture is elongately ovate; the interior of the aperture is traversed by close-set, yellowish spiral ridges. The anterior canal is elongated and roughly about as long as the height of the spire. The shell is more or less deep horny brownish, the spiral grooves on the surface being generally darker brown. The operculum is thick, horny and ovate. Krusadai and Shingle Islands.

Fasciolaria trapezium (Linné).

Plate XVII, fig. 10.

Murex trapezium, Linné, Syst. Nat., Ed. X, 1758, p. 755, No. 493.
Fasciolaria trapezium, Lamarck, Anim. sans vert., (Deshayes' edit.), IX, 1843, p. 433.
Fasciolaria trapezium, Kiener, Coq. Viv., VI, 1840, *Fasciolaria*, p 8, pl. vi.
Fasciolaria trapezium, Reeve, Conch. Icon., IV, 1847, *Fasciolaria*, pl. vii, fig. 16.
Fasciolaria trapezium, Watson, "Challenger", Zoology, XV, 1886, Gastropoda, p. 241.
Fasciolaria trapezium, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 241.

This species is comparatively rare at Pamban and is represented in the collection by a single empty shell from this locality. The shell differs markedly from that of the preceding species in the shoulders on the whorls being much stronger and more angular and sharply defined, and in the tubercles on the shoulders being stouter and more strongly developed. In shape, colouration and general appearance, it resembles closely the shell of *Hemifusus pugilinus* of the family Volemidae, but is readily distinguished from it by its more strongly elevated and sharply pointed spire and a more elongate anterior canal. The columella is arched and bears a few folds below. The interior of the aperture is spirally striated as in the preceding species. The surface of the shell bears a well marked sculpture consisting of numerous spiral striae. The shell is covered with a yellowish brown periostracum when fresh. The surface is pale brownish, marked with fine, dark brown spiral lines which are disposed in pairs. Pamban.

Genus **Fusinus** Refinesque, 1815.

This is treated by Thiele as a sub-section of the genus *Fusus*, (Klein, 1753) Bruguière, 1792. The shell is without an umbilicus, more or less elongately spindle-shaped, with a turretted spire, and, as a rule, sculptured with ribs and spiral ridges. The anterior canal is generally long and slender. The columella is without folds.

Two species, *F. longicauda* and *F. toreuma* have been recorded; of these, the shell of the latter is readily distinguished by the body whorl and base of spire being proportionately broader, and the whorls being more sharply shouldered and more strongly tuberculated on the shouldered part.

Fusinus longicauda (Bory).

Fusus longicauda, Bory, Encyclopédie Méthodique, Vers, 1827, p. 172 and 1816, pl. 423, fig. 2.
Fusus longicauda, Reeve, Conch. Icon., IV, 1872, *Fusus*, pl. iii, fig. 13 (figure not good).
Fusus longicauda, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 290.
Fusinus longicauda, Gravely, Bull Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 62.

This species is closely allied to *F. colus* (a species recorded from Ceylon) and the shell resembles that of the latter in many respects, but may be readily distinguished from it by the sutures being sunk, and by the nodules on the shoulders of the whorls being much less strongly developed. The shell is rather thin, elongately spindle-shaped, with a very slender, greatly elongated anterior canal and a tall, proportionately attenuated spire consisting of numerous whorls. The whorls are rather inflated and their surface is traversed throughout by strong, stout, spiral ridges of which the one occurring in the middle of each whorl is stronger and more markedly raised than the rest. Spiral ridges of more or less uniform thickness occur also on the outer surface of the elongated anterior canal throughout its extent, but they become increasingly oblique towards the extremity of the canal. In addition to the spiral ridges there are broadly rounded transpiral ribs which are more strongly developed on the upper whorls of the spire. The columella and interior of the aperture are smooth. The shell is white throughout. Pamban.

Fusinus toreuma (Lamarck).

Plate XVIII, fig. 1.

Fusus toreuma, Lamarck, Anim sans vert., (Deshayes' edit.), IX, 1843, p. 467.
Fusus toreuma, Kobelt, Conch. Cab., Ed II, 1880, *Fusus*, p. 185.
Fusus toreuma, Reeve, Conch. Icon., IV, 1872, *Fusus*, pl. vii, fig. 27.
Fusus toreuma, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 291.
Fusinus toreuma, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 62.

This species is rare at Pamban and is characterised by a thicker and more solid shell than in the preceding species; the body whorl and base of spire are proportionately broader, the whorls are more sharply angulated about the middle, and each of these angular shoulders bears a spiral row of broadly compressed tubercles; as in *F. longicauda*, the surface of the shell is traversed throughout by thick spiral ridges which are more widely spaced and oblique on the surface of the anterior canal. The anterior canal is stouter and less strongly elongated and attenuated than in the preceding species. The columella bears a thin deposit of callus and the aperture is narrowly ovate. The outer surface of the shell is whitish with irregular dark brown markings arranged roughly in longitudinal rows; the columella and interior of aperture are uniformly white. Pamban.

SERIES VOLUTACEA

Family OLIVIDAE.

The shell is oblong, somewhat barrel-shaped, but generally narrower and more pointed at either extremity. The surface is smooth, highly polished and often ornamented with exquisite colour patterns. The aperture is elongate, and the columellar callus is either smooth or bears feebly developed oblique ridges. The spire is short and its lower part often more or less depressed, but its apex is sharply raised and pointed. The foot has a transverse groove in front. The members of this family are generally burrowing snails.

Two genera, *Oliva* and *Ancilla* are recorded, these being the only genera of this family known from the Madras area also. In *Oliva* there is a distinct posterior canal in the form of a notch between the outer lip and the body whorl ; from this canal there extends a well marked groove along the suture, this groove being occupied by a cord from the mantle during life. In *Ancilla* on the other hand, a posterior canal is absent and there is no sutural groove; the suture bears a dense deposit of callus and the columella is often markedly twisted.

Genus **Oliva** Burguière, 1789.

The shell is elongately ovate, smooth and polished, with a small spire and large, more or less elongate body whorl. The aperture is long and narrow, without a projecting anterior canal. The columella is smooth or bears at most feebly developed oblique ridges. The foot is large and bears a transverse groove in front. These snails generally inhabit sandy places and are burrowing in habit.

Three species have been recorded from Krusadai ; they may be recognized as follows :—

1. Spire rather depressed, colouration rather variable ; body whorl produced into a marked, projecting, slightly curved, beak-like callus thickening at the posterior end of aperture ; anterior and posterior parts of body whorl not markedly differing in colour pattern ... ... *O. oliva.*

— Spire more elevated, its apex being sharp and acuminated ; columella without projecting callosity at posterior end of aperture ; colouration generally as follows : upper part of body whorl ashy blue with pale brownish markings ; lower part, which is generally sharply demarcated from the upper by an oblique spiral line, yellowish white, with dark brown patches 2.

2. Shell stout, body whorl much inflated especially towards the upper part ; the width of the base of the spire usually greater than the length of its sides ... *O. gibbosa.*
— Shell relatively slender, body whorl not markedly inflated, much narrower and more uniform in width ; length of sides of the spire usually greater than the width of the base of the spire ... ... *O. nebulosa.*

Oliva gibbosa (Born).

Plate XVIII, figs. *2a* and *2b*.

Voluta gibbosa, Born, Index Rar. Nat., 1778, p. 202.
Voluta gibbosa, Born, Test. Mus Caes. Vindob., 1780, p. 215.
Oliva utricula, Deshayes, Encyclopédie Méthodique, III, 1832, p. 657.
Oliva gibbosa, Reeve, Conch. Icon., VI, 1850, *Oliva*, pl. viii, fig. 12.
Olivancillaria (Utriculina) gibbosa, von Martens, Journ Linn. Soc., XXI, 1887, p. 185.
Oliva (Agaronia) gibbosa, Melvill & Sykes, Proc. Malac. Soc., III, 1898, p. 40.
Oliva gibbosa, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 138.
Olivancillaria gibbosa, Dautzenberg, Journ. de Conchyl., LXXI, 1927, p. 141.
Oliva gibbosa, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 63.

Living specimens of this common South Indian species of *Oliva* are not uncommonly found burrowing in soft sand at Watchman's Bay and Sandy Point on Krusadai Island. The broad, oblong, disc-shaped foot with a transverse groove in front serves as an efficient burrowing organ. The shell is stout, thick, with a smooth and highly polished surface and an elongately ovoid, somewhat inflated body whorl, the inflation being more strongly marked towards the upper part. The spire is rather short, with a pointed apex. The columella bears a dense, polished, white callus thickening, which is particularly well marked posteriorly while anteriorly it bears numerous, oblique, close-set ridges. The aperture is narrow and elongated, with a small slit-like posterior canal and a broadly open anterior canal in the form of a semilunar notch. Shells collected from Indian shores are generally slightly narrower in proportion to the length than indicated by Reeve's figure of this species. The shell is coloured as described in the key above. Krusadai Island and Pamban.

There are in the Museum collection three small, rather slender shells labelled *Olivancillaria nebulosa* ; but on close examination they appear to be merely young specimens of *Oliva gibbosa* ; they are polished, whitish, with zig-zag, brownish transpiral bands.

Oliva nebulosa Lamarck.

Plate XVIII, fig. 4.

Oliva nebulosa, Lamarck, Anim. sans vert., (Deshayes' edit.), X, 1845, p. 628.
Oliva nebulosa, Reeve, Conch. Icon., VI, 1850, *Oliva*, pl. xvi, fig. 32.
Oliva nebulosa, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 63.

This species is commoner than the preceding in the Pamban area, and numerous specimens, both dead and alive have been collected, but many shells are frequently occupied by hermit crabs. The shell resembles that of the preceding species in the pattern of colouration and in the nature of the columella ; it is, however, readily distinguished from it by the shell being markedly more slender and elongated, with a much less strongly inflated body whorl and a comparatively narrow and elevated spire. The columellar folds are somewhat stronger and more numerous than in *O. gibbosa.* The shell is pale bluish grey or whitish, mottled with greenish blue markings, and, at the base of the body whorl there is a broad, pale brownish, obliquely spiral band with thick-set darker brown markings. The callus deposit on the columella is white, but in some shells it is faintly tinged with purple towards the lower end. Shells of various sizes, ranging from about 5 mm. to over 45 mm. in length are represented in the collection. In young shells the markings are generally bright orange-brown, larger, fewer and tend to take a zig-zag form. Pamban and Krusadai Island.

Oliva oliva (Linné).

Plate XVIII, fig. 3.

Voluta oliva, Linné, Syst. Nat., Ed. X, 1758, p. 729.
Oliva maura, Lamarck, Anim. sans vert., Ed. II, Vol. X, 1822, p. 608.
Cylinder niger, Rumph. Amb Rareitkamer, 1707, p. 119, pl 39, fig. 2.
Oliva maura, Reeve, Conch. Icon., VI, 1850, *Oliva,* pl. vii, fig. 10 (part).
Strephona maura, Gray, Proc. Zool. Soc London, 1858, p 42.
Oliva maura, Melvill & Sykes, Proc. Malac. Soc., III, 1898, p. 39.
Oliva maura, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 251.
Oliva oliva, Dautzenberg, Journ. de Conchyl., LXXI, 1927, p 55.
Oliva oliva, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 63.

Three rather small-sized (probably not quite adult) shells with the soft parts intact are represented among the Pamban collections of the Presidency College and were kindly lent out for study by Prof. S. G. Manavala Ramanujam, but I have also used a few larger shells of this species from Madras and Ceylon, represented in the Museum collection, for purposes of comparison. The shell is thick, elongated and more or less cylindrically oblong, the posterior part of the body whorl being only very slightly inflated in proportion to the remaining parts, quite unlike the condition in *O. gibbosa.* The spire is very small in proportion to the greatly enlarged body whorl and its lower whorls are strongly flattened so as to render the sides of the spire markedly concave. The sutural groove is deep and bounded by a ridge-like thickening of the adjoining parts of the whorls. The columella is thickened with callus and obliquely plicated below. The body whorl is produced into a prominent, beak-like, projecting callosity posteriorly, bounding the small notch-like posterior canal ; but this character is not well marked in the shells from the Presidency College collection, which appear to be young specimens and measure a little over an inch in length ; but the full grown shells from Ceylon are of a much larger size (well over two inches in length) and show the callosity very well. The

shell is variable in colour; two of the Pamban specimens are ashy blue with blackish markings while the third has become almost colourless by preservation in spirit. The larger Ceylon shells, however, are bright yellowish white mottled and clouded with ashy blue spots, and streaked here and there with very dark brown, arrow-head-shaped markings. Pamban.

Genus **Ancilla** Lamarck, 1799.

The shell is small, with a rather reduced, short, conical spire, which is as a rule covered with callus deposit. The body whorl bears at the bottom on the columellar border a deep obliquely spiral furrow above which there are generally two parallel spiral grooves which extend fully over the surface of the whorl, and below which the apertural margin sometimes bears weak grooves. The columella is distinctly twisted. The operculum is elongate.

The four species recorded from Krusadai may be distinguished as follows :—

1. Shell rather slender and elongate, whitish, with the apex and portions of the spire occasionally coloured brown ; spire somewhat narrow and sharply pointed ; sutures definitely impressed though inlaid with callus ; aperture somewhat narrow ; columella slightly twisted ... ... *A. ampla.*

— Shell much stouter and shorter, either brownish or white throughout ; spire broader and its apex markedly blunter ; sutures almost completely obliterated by thick callus ; aperture broader ; columella more strongly twisted ... ... 2.

2. Shell brownish when fresh, generally the double spiral grooves in the lower half of the body whorl and the region *below* the sutures pale or almost whitish ; spire not greatly reduced and its basal portion not partially immersed within the body whorl. 3.

— Shell shorter and stouter in proportion to the length, more or less barrel- or boat-shaped, the body whorl being more strongly inflated ; shell white throughout except at the region of the sutures which is bright orange-brown ; spire very much smaller in proportion to the size of the body whorl, and its base partially immersed within the body whorl ... . *A. scaphella.*

3. Apex of spire conspicuously drawn out into a short, smooth, translucent, glossy papillary projection which

is somewhat pointed and acuminated ; shell pale brownish when fresh ; region of the sutures not particularly dark-coloured ... ... *A. acuminata.*

— Apex of spire broader and blunter, not acuminated ; shell dark horny brown when fresh ; region of the sutures dark chestnut followed by pale or whitish bands immediately below each ... ... *A. cinnamomea.*

Ancilla ampla (Gmelin).

Plate XVIII, figs. 5*a* and 5*b*.

Voluta ampla, Gmelin, Syst. Nat., Ed. XIII, 1791, p. 3467.
Ancillaria candida, Kiener, Coq. Viv., I, 1843, *Ancillaria*, p. 25, pl. v, fig. 4.
Ancillaria ampla, Reeve, Conch. Icon., XV, 1866, *Ancillaria*, pl. viii, fig. 27.
Ancillaria cylindrica, Reeve, ibid., pl. xi, fig. 46.
Ancilla ampla, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 256.
Ancilla ampla, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 63.

This species is moderately common, both dead shells and spirit specimens collected alive being represented in the collection. The shell is somewhat slender and elongate, with a moderately small, but well elevated spire tapering gradually towards the sharply pointed apex. The sutures are densely covered with callus, but their positions can be made out as slight depressions or even as finely impressed grooves. The surface is smooth and highly polished. The aperture is rather narrow and elongate and acutely narrowed posteriorly. The columella is only slightly twisted. The shell is whitish throughout, but almost all shells collected from Pamban are tinted with a bright orange-brown or rusty brown about the spire and apex ; this feature, though not illustrated in Reeve's figure of *A. ampla*, is admitted by him as being of common occurrence in this species and is indicated in his figure of *A. cylindrica* which is but a young shell of *A. ampla*. Living specimens are not infrequently found burrowing in sandy localities, especially at Kundugal Point. Pamban, Krusadai Island and Kundugal Point.

Ancilla cinnamomea (Lamarck).

Plate XVIII, fig. 6.

Ancillaria cinnamomea, Lamarck, Anim. sans vert., (Deshayes' edit.), X, 1845, p. 589.
Ancillaria cinnamomea, Reeve, Conch. Icon., XV, 1866, *Ancillaria*, pl. vii, fig. 19.
Ancillaria cinnamomea, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 138.
Ancilla cinnamomea, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 63.

This species is much better represented than the preceding one in the Pamban area and numerous dead shells as well as living specimens have been collected. The shell is considerably shorter and stouter than in *A. ampla* and is more or less barrel-shaped, broad and rather truncated below, but conically pointed towards the apex. The sutures are almost entirely

obliterated by the thick infilling callus so that the body whorl leads on imperceptibly to the spire as in the case with so many species of the genus. The body whorl is rather strongly inflated, and the two oblique spiral grooves which it bears towards the base are placed much lower than in the preceding species. The aperture is broader and its outer lip bears at the margin a minute tooth at the point of termination of the upper spiral groove. The columellar border of aperture is more strongly twisted and proportionately shorter. The shell is beautifully polished and dark cinnamon-brown when fresh ; the region of the sutures is chestnut with a broad, pale brown or whitish band immediately below each of them ; but most of the shells picked up on the beach are almost completely white except at the sutures which are marked brown even in bleached shells. Living specimens are not uncommon in the surface layers of sand at Watchman's Bay. Krusadai Island and Pamban.

Ancilla acuminata (Sowerby).

Ancillaria acuminata, Sowerby, Thes Conchyl., III, 1866, *Ancillaria*, p. 59, pl. 214, figs. 66 and 67.
Ancillaria acuminata, Reeve, Conch. Icon , XV, 1866, *Ancillaria*, pl. vii, fig. 21

This and the next species are comparatively rare and are represented in the collection only by dead shells. The shell is very similar to that of the preceding species, but is easily distinguished from it by the more strongly raised spire and acuminated apex. The body whorl is slightly more strongly inflated above than in *A. cinnamomea*, but is decidedly more markedly narrowed towards the base than in that species ; the apex is polished and presents a translucent appearance. The condition of the aperture and the columella are more or less the same as in *A. cinnamomea*, and the outer lip of the aperture bears a minute pointed tooth anteriorly as in that species. There are two dead shells from Pamban in the original Museum collection, but these are badly faded and yellowish white throughout. There is, however, a fine, large, highly polished shell of this species from Ceylon in Mr. Crichton's collection showing the colour very well ; it is pale brownish for the most part, but distinctly darker brown towards the base of the body whorl, especially below the oblique spiral groove. The base of the spire is also of a slightly darker brown tint. The sutural regions and the oblique spiral grooves at the base of the body whorl (particularly the upper one which is deeper) are white ; the columella is pure white and glossy. Pamban.

Ancilla scaphella (Sowerby).

Plate XVIII, fig. 7.

Ancillaria scaphella, Sowerby, Thes Conchyl., III, 1866, *Ancillaria*, pl. ii, figs. 37 and 38.
Ancillaria scaphella, Reeve, Conch. Icon., XV, 1866, *Ancillaria*, pl. viii, fig. 26.
Ancillaria scaphella, Weinkauff, Conch. Cab., Ed. II, 1878, *Ancillaria*, p. 39.
Ancilla scaphella, Tryon, Man Conch., V, 1889, p. 96, pl. 39, fig. 53.
Ancilla scaphella, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 25

The shell is stouter and proportionately shorter than in any of the preceding species of *Ancilla.* The spire is very small, with a markedly blunt apex, and with its basal portion partially absorbed within the relatively greatly enlarged and inflated body whorl, which is broad and barrel-shaped, being more or less equally wide at both ends, so that the transition between the body whorl and the spire is rather abrupt and marked by a well marked depression. The aperture is very wide and the columellar border short and twisted. The outer lip of the aperture bears a minute tooth anteriorly as in the preceding species. The oblique spiral grooves are placed far down, very close to the base. The shell is brilliantly glossy and whitish throughout except at the region of the sutures which is tinged with brown. This species is represented in Mr. Crichton's collection by a single fresh shell which is reported to have been dredged alive near Krusadai Island, and by a few more shells in the Museum collection, collected recently from the beach at Krusadai. Krusadai Island.

Family MITRIDAE.

The shell is ovate, or more often spindle-shaped with a spire elongated to a greater or less extent, and a variable sculpture. The aperture is more or less elongate, without distinct anterior canal, and the outer lip is not thickened. The columella almost always bears folds. An operculum is absent. This family includes the mitre shells.

Though numerous species of this family are known from Madras, only a single species, belonging to the genus *Mitra,* has yet been recorded from Pamban.

Genus **Mitra** Lamarck, 1799.

The shell is usually spindle-shaped with a more or less strongly elevated spire and as a rule without radial ribs; either smooth or with spiral sculpture only. The aperture is long and narrow and its outer lip smooth within.

Mitra circula Kiener.

Plate XVIII, fig. 8.

Mitra circula, Kiener, Coq. Viv., 1837, *Mitra,* p. 21, pl. v, fig. 13.
Mitra circulata, Reeve, Conch. Icon., II, 1844, pl. xi, fig. 77.
Mitra circula, Sowerby, Thes. Conchyl., IV, 1874, *Mitra,* pl. vii, (=360) figs, 86 and 87.
Mitra circula, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 65.

A single, rather worn, dead shell taken on the beach of Krusadai Island is the sole representative of this species in the collection. The shell is moderately large, thick, spindle-shaped and its surface uniformly spirally ridged. There are two or three distinct transpiral grooves towards the outer margin of the body whorl. The upper whorls of the spire bear three spiral ridges each, while there are more on the lower whorls. The aperture is narrow and elongated, being slightly longer than the height of the spire. The columella bears three very distinct folds of which the uppermost one is the strongest. The shell is whitish, marked

with broad spiral bands of a pale orange-yellow colour. The record of this species from Pamban needs confirmation by collection and examination of further specimens from the locality. Krusadai Island.

Family VASIDAE (=TURBINELLIDAE).

The shell is usually thick, heavy, solid, with a more or less elevated spire, generally with a tuberculated or spinuous shoulder-ridge ; the anterior canal is elongated and the columella bears strong transverse folds. The animal has a massive, ovoid foot and elongated tentacles. This family includes the familiar chank shells.

A single genus, *Xancus* (= *Turbinella*), is represented at Pamban.

Genus **Xancus** (Bolten) Roding, 1798.
(Syn. **Turbinella** Lamarck, 1799).

The shell is spindle- or pear-shaped with a styliform apex (the larval whorls standing out as a papillary projection at the apex, especially in young shells) and a moderately elevated spire. The outer lip is smooth within and the anterior canal moderately produced and broadly open. The operculum is horny, narrow and elongated.

The true sacred chank, *Xancus rapa*, which is the form taken at the Tuticorin beds, appears to be the only representative of this genus in the Krusadai Island area. It will be observed, however, that in a foot-note to the previous list of Krusadai Mollusca [*Bull Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 95] Dr. Gravely mentions that a single large specimen of *Xancus pyrum* was seen in a lagoon on the south side of Krusadai Island ; this record appears to have been based on incorrect identification, as all the Krusadai chank specimens that were sent to Mr. Winckworth later have been identified by him as *X. rapa* ; in the Museum collection there is no specimen of Krusadai chank labelled *X. pyrum*, which, however, is the form characteristic of the Madras area, and has a comparatively short spire and broader body whorl.

Xancus rapa (Lamarck).
Plate XVIII, figs. 9*a* to 9*d*.

Turbinella rapa, Lamarck, Anim. sans vert., (Deshayes' edit), IX, 1843, p. 377.
Turbinella rapa, Reeve, Conch Icon., IV, 1847, *Turbinella*, pl 11, fig. 8
Turbinella pirum, var. acuta, Hornell, Mem Ind. Mus., VI, 1916, p. 113.
Xancus rapa, Winckworth, Proc. Malac Soc , XXIII, 1939, pt. vi, p. 347.
Xancus rapa, Gravely, Bull. Mad Govt. Mus (Nat. Hist.), V, No. 2, 1942, p. 65.

This species is very well represented at Pamban, and many specimens, both live ones and empty shells in various stages of growth have been collected. The animal generally lives in soft, sandy areas where it may sometimes be seen crawling slowly with its large, powerfully muscular foot. The shell is large, thick, heavy, pear-shaped and covered with

a thick, dark brownish, horny periostracum which peals off in old and worn shells. The spire is well elevated, its outline forming a more or less regular equilateral triangle in adult shells in which the apex is usually simply pointed, but in young shells the sides of the spire are rendered strongly concave, this concavity being accentuated by the presence of a broad, spirally grooved papillary projection at the apex formed by the larval whorls. The body whorl is large and inflated. The whorls bear feebly angulated shoulders, the one on the body whorl being the strongest and most distinct. The shoulder-ridge bears a series of strong, blunt, somewhat compressed tubercles. The surface is closely spirally striated, this striation being more prominent on the basal and upper parts of the body whorl and on the spire, especially in young shells in which the surface may also be rendered slightly undulating by the presence of large, broadly rounded transpirally elongated swellings. The columella is thickened with callus and bears four strong transverse folds of which the lowermost is the smallest and is wanting in very young shells. The anterior canal is wide open and approximately as long as the height of the spire. When the brownish horny periostracum is removed, the shell appears uniformly ivory white all over, but young shells are marked all over with small, brown spots. Hornell (*loc. cit.*) treats *X. rapa* as *var. acuta* of *Turbinella pirum*, and distinguishes three local races of this form, namely, the Tuticorin, Kilakarai and Rameswaram races. Pamban, Krusadai and Shingle Islands.

Family HARPIDAE.

The shell is thick, large, ovoid, more or less bulged, with a small spire and large, inflated body whorl, and very strongly transpirally ribbed throughout. The columella bears a smooth, polished callus, but without folds, and the aperture more or less wide, without well defined anterior canal. An operculum is absent. The foot is very large, broad in front, narrowed and pointed behind and with lateral lappets. The head is small, with thick, close-set and sharply-pointed tentacles. This family includes the harp shells.

A single genus, *Harpa*, is included in this family.

Genus **Harpa** (Rumph) Walch, 1771.

With the characters of the family.

A single species, *H. conoidalis*, known also from Madras, is represented at Krusadai.

Harpa conoidalis Lamarck.

Plate XIX, figs. 1*a* and 1*b*.

Harpa davidis, Röding, Mus. Bolten., 1798, p. 150.
Harpa conoidalis, Lamarck, Anim. sans vert., (Deshayes edit.), X, 1845, p. 131.
Harpa conoidalis, Reeve, Conch. Icon., I, 1843, *Harpa*, pl. iii, fig. 7.
Harpa conoidalis, Crichton, Journ. Bomb. Nat. Hist. Soc., XLII, 1941, p. 330.
Harpa conoidalis, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 67.

The habits of this animal are well described by Mr. Crichton (vide reference above); its remarkable power of throwing off part of the foot when irritated (autotomy) is particularly noteworthy. The species is rather rare at Pamban, whence only a single empty shell is represented in the collection. The shell is large, brightly coloured and exquisitely polished. The strong, broadly rounded transpiral ribs are rather widely spaced, smooth, glossy and pale fleshy brown marked with darker brown transverse lines and bars. The ribs are strongly spined a little below the suture. The broad interspaces between the ribs are traversed by fine, close-set, transpiral striae and are ornamented with a characteristic festooned pattern of brownish lines. The columella is smooth and brilliantly polished, and bears a large, diffused, chestnut blotch. The interior of the aperture is whitish, tinged with smoky brown. The colouration, however, is subject to considerable variation. Pamban.

Family VOLUTIDAE.

The shell is usually considerably large, spindle-shaped or ovoid; the columella is sometimes with, and sometimes without folds. An operculum is sometimes present, but more often it is wanting. The foot is large and broad. The head bears a large fold carrying the eyes (which are sometimes absent) on its sides and the moderately short tentacles on its anterior margin. The melon-shells and volutes are included in this family.

Two genera, *Cymbium* (=*Melo*) and *Voluta* are represented; the former, which includes the typical melon-shells, may be readily distinguished from the latter by the shell being much larger, smoother, more evenly rounded, comparatively thin and elongately ovoid with a greatly inflated body whorl and by the spire being reduced and much smaller in proportion to the body whorl.

Genus **Voluta** Linné, 1758.

The shell is thick, ovoid, with a smooth, papilliform embryonic shell The spire is broadly conical and the whorls often bear tubercles or crudely developed nodular swellings spirally arranged and forming a shoulder-ridge. The aperture is elongated, sharply angular above and broadened below. The columella bears numerous folds.

A single species is recorded from Pamban.

Voluta lapponica Linné.

Plate XIX, figs. 2*a* and 2*b*.

Voluta lapponica, Linné, Syst. Nat, Ed. XII, 1767, p. 1195.
Voluta interpuncta, Martyn, Univ. Conch, IV, 1792, pl. 127.
Voluta indica, Sowerby, Thes. Conchyl, I, 1845, p 210, pl. 51, figs 68-70.
Voluta interpuncta, Reeve, Conch. Icon, VI, 1849, *Voluta*, pl. vi, 1792, fig. 12.
Voluta interpuncta, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 136.
[Now usually separated from *Voluta* as *Harpularia lapponica* (Linné)].

A single shell of this species from Pamban was originally contained in Mr. Crichton's collection, but was later sent to Mr. Winckworth. This species is rare at Pamban, but more specimens have been collected from Ceylon and Tuticorin. The shell is fairly large, thick, ovoid, with a short, conical spire and elongately inflated body whorl. The South Indian specimens are generally more elongated in proportion to the width than is indicated by Reeve's figure of this species. The two uppermost whorls of the spire form an erect, papilla-like projection which generally gets broken off leaving the apex somewhat blunt in worn shells washed up on the beach. The next two whorls of the spire bear well defined transpiral ribs, while the body whorl and the lower whorls of the spire are practically smooth, but feebly and convexly shouldered round the upper part, where they also bear a few, weakly developed, sometimes almost obsolete, nodules. The columella bears about six or seven oblique folds which get successively smaller from below upwards. The aperture is rather narrow and elongate, and the outer lip slightly thickened within. The shell is pale yellowish white marked all over with spiral rows of fine, orange-brown dots and dashes. There are also one or two bands of indistinct brownish patches. Pamban.

Genus **Cymbium** (Klein) Roding, 1798.

The shell is large, elongately ovoid, with a large, dome-shaped embryonic shell; the succeeding whorls are smooth and the body whorl is very greatly enlarged. The aperture is very wide and elongate. The columella bears four, seldom three, very oblique folds.

The familiar melon-shell (or 'beggar's bowl'), which is the sole Indian representative of the genus, is recorded from Pamban.

Cymbium melo (Solander).

Plate XIX, fig. 3.

Voluta melo, Solander, Catalogue, Portland Museum, 1786, p. 41.
Voluta indica, Gmelin, Syst. Nat., Ed. XIII, 1791, p 3467.
Cymbium tranquebaricum, Roding, Mus. Bolten, 1798, p. 152.
Melo indicus, Sowerby, Thes. Conchyl., I, 1847, p. 413, pl 81, figs. 1—5.
Melo indicus (Anatomy), Fleure, Rec Ind. Mus., VII, 1912, p. 405.
Melo indica, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 136.
Cymbium melo, Gravely, Bull Mad. Govt. Mus., (Nat Hist.), V, No. 2, 1942, p. 67.

The shell is very large, rather thin for its size, and ovoid, with an enlarged, strongly inflated body whorl, almost completely enveloping the reduced spire in adult specimens. Dr. Gravely very aptly compares the adult shell to a gigantic *Bulla*, as it resembles the latter closely in shape and proportions. But in young shells the spire is exposed and forms a broadly rounded, cap-shaped structure above the body whorl. The surface bears conspicuous transpiral growth striae, but is otherwise entirely smooth and unsculptured. The aperture is very wide and elongated, with a very broad and deeply excavated notch at the lower end representing the anterior canal. The shell is bright yellowish orange in colour

throughout, with a few dark or chestnut-brown patches about the middle of the body whorl. This species is fairly common on Indian shores, but specimens are scarce at Pamban. Rameswaram and Pamban.

Family MARGINELLIDAE.

The shell is usually small, ovate or pear-shaped, as a rule smooth and polished, seldom sculptured The spire is conical, but more often absorbed within the body whorl. The aperture is more or less elongated and narrow, the outer lip often thickened and the columella folded anteriorly. An operculum is absent. The foot is large.

The only South Indian genus of this family, *Marginella*, is represented at Pamban by a single species.

Genus **Marginella** Lamarck, 1801.

The outer lip is usually thickened externally and smooth or more rarely toothed within. The columella as a rule bears four oblique folds, sometimes three, five or six.

Marginella angustata Sowerby.

Plate XIX, figs. 5*a* and 5*b*.

Marginella angustata, Sowerby, Thes Conchyl, I, 1846, *Marginella*, p. 399, pl 77, figs. 169 and 170.
Marginella angustata, Reeve, Conch. Icon, XV, 1864, *Marginella*, pl. xiii, fig. 55.
Marginella angustata, Hornell, Common Molluscs of South India, Mad Fish. Bull, XIV, 1921, p. 139
Marginella angustata, Crichton, Journ Bomb Nat Hist Soc, XLII, 1941, p. 335.
Marginella angustata, Gravely, Bull. Mad. Govt. Mus (Nat Hist), V, No 2, 1942, p. 69.

Numerous dead shells of this species are commonly found washed up in fairly fresh condition on the beach on Krusadai Island. The shell is small, smooth, ovoid and not unlike that of a small *Cypraea* in shape and appearance. The spire is completely enveloped within the body whorl in the adult. The surface of the shell displays a fine gloss in fresh and unworn shells. The body whorl is elongately ovoid, being broader towards the spire than anteriorly. The aperture is narrow and elongated and the outer lip thickened and smooth within. The columella bears four oblique folds of which the three upper ones are strongly developed and well separated, while the fourth is very small and only imperfectly separated from the fold next above it. Except for a somewhat broad, feebly marked, dull white band on the outer margin, the surface of the shell is ornamented throughout with a characteristic colour pattern of greyish brown spiral bands of varying width, decussated by fine whitish longitudinal lines on a bluish white ground. The shells collected from Krusadai are all rather small, scarcely exceeding a length of about 1 5 cm., but there are a few, fine, comparatively large shells from Tuticorin and Madras in Mr. Crichton's collection. Pamban and Krusadai Island.

Order Toxoglossa.

Family TURRIDAE.[1]

The shell usually bears a strongly elevated spire. The columellar projection is often elongated, sometimes moderately short. The outer lip of the aperture bears a distinct notch towards its upper end. The operculum is horny, with either a marginal or a central nucleus.

This family, which is very richly represented at Madras, is curiously enough scarce at Pamban, only a single species belonging to the genus *Brachytoma* being recorded from this locality.

Genus **Brachytoma** Swainson, 1840.

The shell is elongately spindle-shaped, with turretted and pointed spire, broad transpiral ribs and fine spiral ridges ; the body whorl bears a moderately elongated columellar projection, and the aperture a somewhat shortened anterior canal. The outer lip is sometimes thickened.

Brachytoma crenularis (Lamarck).

Plate XIX, fig 4.

Pleurotoma crenularis, Lamarck, Anim sans vert, VII, 1822, p. 92
Pleurotoma crenularis, Reeve, Conch. Icon, I, 1843, *Pleurotoma*, pl vii, fig. 54.
Brachytoma crenularis, Gravely, Bull. Mad Govt. Mus (Nat Hist), V, No 2, 1942, p 75

A single shell, taken on the beach on Krusadai Island, is represented in the collection. Though the shell is roughly spindle-shaped, the widest part of the shell is somewhere below the middle, the height of the spire being definitely greater than the height of the body whorl. The whorls are strongly and angularly shouldered, and this gives the spire a well marked turretted appearance. The surface bears strong, transpirally elongated, broadly rounded ribs, and fine, but sharply defined spiral ridges, in the interstices between which there are still finer spiral striae ; a low, keeled spiral rib, generally made up of two close-set spiral ridges, is present just below the suture and the portion of the surface immediately below this rib is somewhat deeply hollowed. The notch on the outer lip is deep and rounded while the callus deposit on the columella and the interior of the aperture are finely polished. The shell is brownish, but the brown colour is concentrated in the interstices between the transspiral ribs and the hollow band below the suture, while the ribs themselves tend to be paler or whitish. Krusadai Island.

[1] This family is closely related to the next, and has been included in it by Thiele as a sub-family ; but the shells of the two groups differ so markedly in shape and proportions that I have thought it desirable to follow Dr. Gravely in keeping the two families distinct.

Family CONIDAE.

The shell is usually cone-shaped, the apex of the cone being below and representing the lower (anterior) end of the body whorl. The spire is generally very low and depressly conical. The aperture is narrow, elongated and generally bounded by straight, parallel lips. An operculum, with a terminal nucleus, is present.

This large family, which, in its strict sense, is treated by Thiele as a sub-family (*Coninae*), comprises the shells commonly known as the cone shells—a very distinct group of Gastropods—included in the single genus of the family, namely, *Conus*. The Pamban species of this family are more numerous than the Madras ones, and strangely enough, only a single species is common to both these localities.

Genus **Conus** Linné, 1758.

The characters of the genus are the same as those of the family.

Fourteen species of *Conus* have been recorded from the Krusadai Island area; they may be distinguished as follows:—

1. Apex sharp, pointed, spire well developed and considerably raised, and not concavely depressed; angular portions of the whorls smooth or keeled, not tuberculated 2

— Apex blunt, spire relatively flattened, sometimes very markedly so, and more often even concavely depressed; angular portions of the whorls usually raised into sharply angular nodules or tubercles, notch between outer lip and body whorl at the posterior end deep and well excavated 10

2. Shell more or less perfectly conical in form, the sides of the body whorl being straight and tapering downwards in a strictly conical fashion; aperture more or less of equal width throughout 3

— Shell not strictly conical in form, the body whorl being more or less inflated, with a more rounded contour and with a relatively broad base; aperture generally markedly broader in front than behind 11

3. Shell rather elongate, about twice as high as the width of the broadest part of the body whorl, sides of spire strongly concave and upper portion of spire slender and markedly acuminated; basal part of body whorl spirally grooved 4

— Shell stouter, not more than one and a half times as high as the width of the broadest part of the body whorl, sometimes even shorter ; sides of spire not concavely depressed, more or less straight and its upper portion not slender and narrowly drawn out, base of body whorl not spirally grooved 6

4. Shell attaining a somewhat large size, with a considerably broad and deep apertural cleft ; surface of the whorls of spire with numerous equally strong spiral grooves ; shell with a characteristic colour pattern of irregular spiral bands of small, white, triangular markings on a brownish ground colour ; spiral grooves on basal part of body whorl finely punctured ; common ... ... *C. amadis.*

— Shell much smaller, with the apertural cleft narrower and shallower ; surface of the whorls of spire relatively smooth, but with a single medial deeply impressed spiral groove ; colour pattern of shell not as above, generally whitish, with a few scattered brownish spots or blotches ; spiral grooves on basal part of body whorl not finely punctured as above, and generally extending up to the middle of the body whorl ; rarer 5

5. Shell rather small, and proportionately narrow ; surface traversed by fine, transpiral striations ; angles on the whorls of spire more strongly developed and raised into very thick, ridge-like fillets ; shell bluish white, marked with spiral bands of brownish dots and blotches ... ... *C. dispar.*

— Shell somewhat larger and slightly broader ; surface of shell smoother and more glossy ; angles on the whorls of spire less strongly developed and not markedly raised into such strong, ridge-like fillets ; shell whitish, with a characteristic colour pattern of closely reticulated brownish patches on a white ground ... . *C. acuminatus.*

6. Shell as a rule somewhat small, often only slightly over an inch in height, but very stout and broadly conical, the widest part of the body whorl being well over three-fourths of the height of the shell ; upper part of body whorl rather bluntly rounded ; spire, though somewhat raised, convexly rounded above and apex generally not sharply pointed ; columellar

border of aperture slightly convexly arched and apertural cleft rather narrow and shallow 7

— Shell larger, attaining on the average a height of about two inches or more ; not so stout and broad, considerably more elongate in proportion to maximum width of the body whorl ; upper portion of body whorl more sharply angular ; spire more perfectly conical with straighter sides and apex well defined and sharply pointed ; columellar border of aperture straighter and apertural cleft deeper 8

7. Upper part of body whorl and whorls of spire not coronated (i.e., not beset with a row of tubercles), or at most bearing very weak, ill defined or almost obsolete nodular swellings ; shell marked with a bold and characteristic colour pattern of large, squarish or D-shaped dark brownish or almost blackish brown, close-set patches disposed in regular, spiral rows ... *C. ebraeus.*

— Upper part of body whorl and whorls of spire generally coronated (i.e., beset with a row of raised tubercles, but these may not be distinct in worn shells) ; shell not with the above colour pattern ; usually pinkish or bluish white, marked with two broad, pale-coloured spiral bands, one above and one at the middle, and numerous thin spiral lines made up of alternate segments of white and dark brown, the positions of these lines being marked by slightly raised, thin fillets . . .. *C. coronatus.*

8. Profile of conical body whorl slightly convexly arched and shell somewhat shorter in proportion to the greatest width of the body whorl ; spiral ridges confined to basal portion of body whorl ; shell whitish, spirally traversed by numerous, very fine, close-set, thread-like, orange lines and irregularly blotched with orange-brown markings, the latter generally tending to form transpiral bands .. . . *C. lineatus.*

— Profile of body whorl more perfectly conical with much straighter sides and shell more elongated in proportion to greatest width of the body whorl ; fine spiral ridges or raised striae present and extending throughout the surface of the body whorl ; shell not coloured as above, generally pale reddish brown with a broad, pale or white spiral band running across the middle of the body whorl ; spiral ridges generally marked with fine brownish dots 9

9. Spire considerably raised, with the apical part slightly exserted ; upper part of body whorl not coronated ; lowermost part of each whorl of spire somewhat strongly marked as a ridge-like elevation owing to slight depression of the sutures ; base of body whorl not appreciably darker than the rest of the surface ; common ... ... *C. piperatus.*

— Spire considerably less elevated with the apical portion comparatively blunt and not exserted ; upper angular part of the body whorl beset with feebly developed, but distinct, broadly rounded, whitish nodules (which may, however, be indistinct in very worn shells) ; lowermost part of each whorl of spire flattened and not raised as a ridge-like elevation, the sutures being less strongly depressed ; base of body whorl generally darker than the rest of the surface ; rarer .. ... *C. lividus.*

10. Shell large, thick, heavy, solid and smooth, whitish or tinged with pale fleshy pink and characteristically ornamented with very fine closely reticulating brownish lines and two (or sometimes three) somewhat interrupted, broad, blackish brown spiral bands round the body whorl .. .. *C. araneosus.*

— Shell smaller, thinner and less massive, surface traversed uniformly by fine, spiral grooves ; shell ornamented with a very bold, characteristic and prettily marked pattern of a rather open network of dark or blackish brown coalesced markings, enclosing more or less triangular, whitish patches which represent the meshes of the dark-coloured network . *C. marmoreus.*

11. Shell large, aperture considerably broad ; surface of spire as a whole, as well as surface of each whorl of spire, rather markedly concavely depressed , upper part of body whorl and whorls of spire with strong, keel-like, angular shoulders ; apex of spire sharply elevated and pointed ; surface generally smooth or at most feebly striated 12

— Shell smaller ; aperture narrower ; spire as a whole markedly convexly arched and surface of the whorls of spire not concavely depressed ; whorls smoothly rounded and without angular shoulders ; apex of spire considerably blunter and not sharply elevated ; surface distinctly traversed by raised spiral striae ... 13

12. Shell rather thin, body whorl more strongly inflated, and smooth throughout; angular shoulders on the whorls beset with broadly compressed tubercles which give an undulating contour to the angular parts; aperture very wide below; shell pale pinkish or bluish white, very largely and diffusely blotched with light brown ... . *C. geographus.*

— Shell thicker and more solid, with the body whorl less broadly inflated; very finely spirally striated throughout the surface; angular shoulders on the whorls smooth and even, without tubercles, but sharply and uniformly raised into a thin keel-like fillet; aperture narrower below; shell whitish, slightly tinged with pale reddish brown and very conspicuously marked with irregularly interrupted longitudinally disposed blackish brown bands and blotches . .. . *C. gubernator.*

13. Shell small, rather short in proportion to the width; pale violet, often with an indistinct brownish spiral band (with whitish zones just above and below it) across the middle of the body whorl; common .. .. *C. glans.*

— Shell larger, rather narrow and much more elongate in proportion to the width; whitish, irregularly blotched with orange brown and prettily ornamented with regular spiral rows of fine, dark reddish brown dots throughout the surface of the body whorl; in the whorls of the spire these dots are confined to the sutural regions, rarer .. .. *C. nussatella.*

Conus amadis Gmelin.

Plate XX, figs. 1*a* and 1*b*.

Conus amadis, Gmelin, Syst. Nat, Ed XIII, 1791, p. 3388
Conus amadis, Kiener, Coq. Viv, 1847, *Conus*, p. 120
Conus amadis, Lamarck, Anim. sans vert, VII, 1822, p 489.
Conus amadis, Reeve, Conch. Icon, I, 1844, *Conus*, pl. xli, fig 222.
Conus amadis, Crichton, Journ Bomb Nat Hist Soc., XLII, 1941, p 330.
Conus amadis, Gravely, Bull Mad Govt Mus (Nat Hist), V, No 2, 1942, p 78.

This is by far the commonest species of *Conus* to be taken alive at Pamban, and is reported to be abundant also at Ceylon. Numerous specimens, both dead shells and live specimens, have been collected, particularly from the mud flats at Kundugal Point where they are often found half buried in the sand exposed at low tide. The shell is moderately large, with the body whorl in the form of an inverted, typically straight-sided cone, and a well elevated spire, the sides of which are concavely excavated, and a sharply raised,

acuminated and pointed apex. The body whorl is sharply angular above, the angular part being somewhat strongly raised and keel-like. The whorls of the spire are also distinctly angled immediately above the suture and their surface is finely spirally grooved. The body whorl is smooth above, but towards the base its surface is obliquely spirally grooved, these grooves presenting a peculiar, punctured appearance on close examination. The shell is dark brownish or orange-brown, profusely marked with irregularly scattered, whitish, triangular (or arrow-head-shaped) patches, the apices of these markings being directed away from the columella. The whorls of the spire are marked with a bold pattern of large alternating patches of white and brown. Shells from Madras generally tend to be of a paler brown ground colour than those from the Pamban area. Kundugal Point and Pamban.

Conus amadis is the only species that has been collected alive from the littoral region at Pamban. All the remaining species of *Conus* are represented in the collection only by dead shells.

Conus piperatus Dillwyn.

Plate XX, figs. *2a* and *2b*.

Conus piperatus, Dillwyn, Catalogue of Shells, 1817, p 401.
Conus filis punctatis cinctus, Chemnitz, Conch. Cab., X, 1788, p. 36, pl 239, fig. 1294.
Conus punctatus, Bruguière, Encyclopédie Méthodique, Vers, 1792, p. 628.
Conus punctatus, Lamarck, Anim sans vert , VII, 1822, p. 455.
Conus punctatus, (pars) Reeve, Conch. Icon , I, 1843, *Conus*, pl. xxiv, fig 133*b* (not *a* & *c*).

Dead shells of this species may be found plentifully washed up on the beach on Shingle Island, but many of the shells collected are in a more or less worn condition. The spire is moderately raised, with a sharply pointed, slightly exserted apex, and is regularly conical instead of its sides being concavely excavated as in the preceding species. The shell is moderately large, thick, solid, with a straight-sided, conical body whorl which is distinctly angular above, but the angular part is smooth and not coronated. The whorls of the spire are also slightly raised into a ridge-like thickening immediately above the sutures. The surface of the shell bears fine, slightly raised spiral striae. The aperture is narrow, elongated and almost strictly parallel-sided. The shell is of a very pale pinkish brown colour, with a characteristic white or pale, broad spiral band across the middle of the body whorl, and a few irregular longitudinal brownish streaks ; the raised spiral striae are marked with rows of fine brown spots. The spire is obliquely streaked with large chestnut markings. The interior of the aperture is whitish tinged with pale violet. Shingle Island.

Conus lividus Hwass.

Conus lividus, Hwass, Encyclopédie Méthodique, Vers , I, pt. 2, 1792, p. 630, pl. 321, fig. 5.
Conus lividus, Lamarck, Anim. sans vert., VII, 1822, p. 457.
Conus lividus, Reeve, Conch. Icon., I, 1843, *Conus*, pl. xxxviii, fig. 211.
Conus lividus, Sowerby, Thes. Conchyl., III, 1866, *Conus*, p. 4, pl. ii, fig. 27.
Conus lividus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 386.

The shell resembles very closely that of the preceding species, but specimens are comparatively rare. Mr. Crichton's collection contains a single shell from Galle coast, and a few shells from Shingle Island are represented in the Museum collection. The shell differs from that of *C. punctatus* chiefly in having a considerably less elevated spire with a markedly blunter apex and the angular upper part of the body whorl being raised into large, whitish, broadly rounded tubercles (i.e., coronated), but in worn shells the tubercles may be very indistinct The surface bears raised spiral striae, the lowermost of which are stronger and sometimes even granular. The whorls of the spire have almost evenly flattened or slightly convex surfaces, but their lower parts are raised into series of rounded nodules ; the spiral sculpture on the whorls of the spire are finer and often reduced to close-set grooves. The thick greenish brown periostracum persists largely in fresh specimens. The shell is pale fleshy brown, with a broad, central, white, spiral band across the middle of the body whorl, while the basal part of the body whorl is often dark purplish brown. The spiral striae are sometimes sparsely dotted with brown, while the spire bears large dark brown patches. Shingle Island.

Conus acuminatus Bruguière.

Plate XX, fig. 3.

Conus acuminatus, Bruguière, Encyclopédie Méthodique, Vers., I, pt. ii, 1792, p 688.
Conus acuminatus, Lamarck, Anim sans vert , VII, 1822, p 488
Conus acuminatus, Reeve, Conch Icon., I, 1843, *Conus*. pl xxxi, fig 173.

This species is also equally scarce at Pamban. The shell is rather small, with a fairly strongly elevated spire, the sides of which are deeply concave. The body whorl is strongly angular above, this angular part and the lowermost part of each whorl of spire being somewhat sharply raised and keel-like, and which in the upper whorls of the spire present a slightly nodular appearance. The surface of the body whorl is strongly spirally grooved from the base upwards to about its middle, but the upper half of the surface is perfectly smooth, and the whole surface displays a slight gloss. These spiral grooves are seen to be finely punctured on close examination, as in *C. amadis*, but less conspicuously. The surface of each whorl of the spire is also strongly concavely depressed and bears a medial spiral groove. The apex is acuminated and sharply pointed. The aperture is narrow and elongated and the cleft between the outer lip and the body whorl is considerably deep The shell is whitish, marked profusely and irregularly with brown patches all over, but in the spire the patches are darker, larger and more widely spaced, leaving large, clear spaces of the ground colour between them. Krusadai and Shingle Islands.

Conus dispar Sowerby.

Conus dispar, Sowerby, Conch. Illustr., 1833, fig. 57.
Conus dispar, Reeve, Conch Icon., I, 1843, *Conus*, suppl., pl. iv, fig. 238.

The shell is smaller than in the preceding species, but otherwise resembles the latter rather closely in form and appearance The upper part of the body whorl and the bottom of each whorl of the spire are sharply angled, raised and keel-like. The surface of the elevated spire as well as that of each whorl of the spire is concavely depressed, and the apex is acuminated and sharply pointed. The whorls of the spire bear a medial spiral groove as in the preceding species, but is much less strongly marked. The lower half of the body whorl bears fine, thread-like grooves which are slightly more numerous, close-set and less distinctly pitted than in the preceding species. The surface of the shell is also finely trans-spirally striated throughout. The outer lip is thin and the aperture very narrow, but the apertural cleft between the outer lip and the body whorl at the posterior end is deep. The shell is white, marked with brown spots and markings disposed in spiral bands, but the colour is badly faded in the only shell available in the collection. Pamban.

Conus coronatus Dillwyn.

Plate XX, fig. 4.

Conus coronatus, Dillwyn, Catalogue of Shells, I, 1817, p. 403.
Conus minimus, Lamarck, Anim. sans vert., VII, 1822, p. 450.
Conus minimus, Reeve, Conch Icon., I, 1843, *Conus*, pl xxvi, fig 143
Conus minimus, Kiener, Coq. Viv , II, 1846, *Conus*, p. 64, pl xiv, fig 1.
Conus minimus, Sowerby, Thes. Conchyl , III, 1866, *Conus*, p 9, pl iii, figs 54 and 55 , pl. v, figs 99 and 111.
Conus (*Mures*) *coronatus*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 381

This species is well represented at Pamban, and a number of shells have been collected especially from the beach on Shingle Island. The shell is rather short, but very stout and solid, the width of the broadest part of the body whorl being much greater in proportion to the height of the shell than in most other species recorded from the locality. The spire is considerably elevated with a convexly rounded surface and an obtuse, blunt apex. The upper part of the body whorl is angular, but much less sharply than in the two preceding species. The angular shoulder on the body whorl and the lower part of each whorl of the spire are strongly coronated (i.e., bear short, rounded or angular tubercles) but this feature may be very ill defined in worn shells washed up on the beach. The surface bears numerous, regular, evenly and somewhat widely spaced, raised, thin, thread-like spiral ridges each of which is marked with alternate segments of white and dark brown. The aperture is slightly wider below than above, and the apertural cleft at the posterior end is very shallow. The shell is greyish blue, diffusely blotched with olive green patches and encircled with two somewhat broad spiral bands of pale bluish or pinkish white, one along the middle of the body whorl and the other on the same whorl in the region of the tubercles above. The whorls of the spire are spirally banded with white and brown. The shell is most readily distinguished by the alternate white and brown markings on the raised spiral fillets. Krusadai and Shingle Islands.

Conus ebraeus Linné.

Plate XX, fig. 5

Conus ebraeus, Linné, Syst Nat , Ed X, 1758, p 715, No. 268
Conus hebraeus, Reeve, Conch. Icon , I, 1843, *Conus*, pl xix, fig. 104 *b*.
Conus hebraeus, Kiener, Coq Viv , II, 1846, *Conus*, p 45, pl. iv, fig 2.
Conus ebraeus, Sowerby, Thes Conchyl , III, 1866, *Conus*, p 9, pl iii, fig 56
Conus (Mures) hebraeus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr., XLIX, 1908, p 381.
Conus hebraeus, Hornell, Common Molluscs of South India, Mad Fish Bull., XIV, 1921, p 140.

Specimens of this species, though occasionally washed up on the beach, especially on Shingle Island, are much less common than those of the preceding species The shell resembles that of *C coronatus* in size and proportions. The spire is convexly rounded with a blunt spire and the body whorl broadly conical. The surface bears fine, raised spiral striae which are stronger towards the base. The upper part of the body whorl is very bluntly angular and much less distinctly coronated than in the preceding species, the tubercles, which are found only in unworn shells, being small and somewhat compressed. The nature of the aperture and the cleft between the outer lip and the body whorl is almost exactly the same as in *C coronatus* , but the shell may be readily distinguished from the latter by its characteristic colour pattern , it is whitish, or slightly tinged with pink, and marked with a very bold pattern of three or four broad, spiral bands of large, squarish or D-shaped blackish brown patches One shell in the collection retains a distinct yellowish brown periostracum on the surface Pamban and Shingle Island.

Conus lineatus Chemnitz.[1]

Conus lineatus, Chemnitz, Conch Cab , X, 1788, p 27, pl 138, fig 1285.
Conus lineatus, Reeve, Conch. Icon , I, 1843, *Conus*, pl xxiii, fig 131.
Conus lineatus, Kiener, Coq Viv , II, 1847, *Conus*, p. 107, pl xviii, fig 4
Conus lineatus, Sowerby, Thes Conchyl., III, 1866, *Conus*, p. 36, pl x, figs. 218 and 219
Conus (Dauci) lineatus, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 387.

This species is rare at Pamban, only a single empty shell with the outer lip slightly broken, being represented in the collection The shell is moderately large and solid, resembling that of *C. puntatus* in shape and general appearance, but the profile of the sides of the body whorl is slightly more convexly arched and the shell somewhat broader in proportion to the height The spire is moderately elevated with a sharp and pointed apex and its whorls bear more or less flattened surfaces The aperture is narrow and elongated with its columellar border convexly arched, while the apertural cleft is moderately deep The shell is irregularly marked with patches and bands of dark yellowish brown, the bands often extending transpirally, but there are portions of the white ground colour left clear in the form of two or three broad, ill defined spiral bands ; in addition to these markings, the shell bears

[1] Mr Winckworth reports that this name has recenttly been invalidated, as the same name has been used for a fossil by Solander.

throughout its surface very fine, close-set, thread-like, orange-brown spiral lines which are particularly pronounced on the coloured parts of the surface. Krusadai Island.

Conus glans Hwass.

Plate XX, figs. *6a* and *6b*.

Conus glans, Hwass, Encyclopédie Méthodique, Vers, 1792, p 735, pl 342, fig. 7.
Conus glans, Reeve, Conch. Icon., I, 1843, *Conus*, pl xxvi, fig. 145.
Conus glans, Kiener, Coq Viv, II, 1850, *Conus*, p. 300, pl. 80, fig. 1*a*.
Conus glans, Sowerby, Thes. Conchyl, III, 1866, *Conus*, p 46, pl. xxii, fig. 530.
Conus (Terebri) glans, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 394.

This species is very common and is represented in the collection by numerous shells which are frequently found on the beach in large numbers The shell is rather small, moderately narrow and more or less ovoid, having lost the typical cone-shape characteristic of the genus. The body whorl is elongately ovate, with somewhat inflated and convexly arched sides, broad above and tapering below The upper part of the body whorl is very obtusely and feebly angled, or more often nearly evenly rounded, merging gradually into the dome-shaped spire, this part of the body whorl is smooth and not coronated as in the preceding species The spire is considerably raised and convexly rounded, with a more or less bluntly rounded apex, which, however, may sometimes be feebly exserted. The surface of the shell is traversed by raised spiral striae throughout; these striae are sometimes finely and indistinctly granulated The aperture is elongated, very narrow and slit-like above, but relatively broad below. The outer lip is thin and almost always found broken in shells taken on the beach. The apertural cleft is very shallow. The shell is pale violet in colour, whitish towards the spire, and marked with a broad, brownish spiral band across the middle of the body whorl; there is often a whitish or pale spiral zone immediately above and below this band. The shells are particularly common on the Shingle Island beach Krusadai and Shingle Islands

Conus nussatella Linne.

Plate XX, fig. 7.

Conus nussatella, Linné, Syst. Nat. Ed X, 1758, p 716, No 273.
Conus nussatella, Reeve, Conch Icon, I, 1843, *Conus*, pl. xi, fig 56.
Conus nussatella, Kiener, Coq. Viv, II, 1850, *Conus*, p 299, pl 53, fig 2
Conus nussatella, Sowerby, Thes. Conchyl, III, 1866, *Conus*, p. 45, pl 23, figs 553 and 554.
Conus (Terebri) nussatella, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 394.

This species is rare in the Pamban area, only three shells, of which two are rather badly worn, taken on the Shingle Island beach, being represented in the collection. Mr. Crichton's collection also contains two smaller, but much fresher shells from Ceylon, labelled *C. atroptus*, but on scrutiny they are found to be correctly referable to the present species. The shell is

moderately large, narrow, elongate and more or less shuttle-shaped, being evenly cylindrical at the middle part and obtusely tapering at both ends, the typical cone-shape being even less evident than in *C glans*. The upper part of the body whorl is almost evenly rounded and smooth. The spire is convexly rounded and bears a pointed apex The surface of the shell is traversed throughout by fine, raised, close-set spiral striae which sometimes tend to be indistinctly granulated ; in worn shells these striae are very ill defined. The whorls of the spire are slightly convex and traversed by spiral striae which are much finer and more close-set than those on the body whorl. The aperture is greatly elongated, very narrow above, but broader below, the columellar border here being slightly concave. The shell is whitish with diffuse orange-brown markings, and neatly marked throughout with regular spiral rows of small, dark reddish brown dots ; in the spire these dots are confined to the region immediately above the suture. Shingle Island

Conus geographus Linné.[1]

Plate XX, figs. 8*a* and 8*b*.

Conus geographus, Linné, Syst Nat , Ed X, 1758, p 718, No 283.
Conus geographus, Reeve, Conch Icon , I, 1843, *Conus*, pl. xviii, fig 130
Conus geographus, Kiener, Coq Viv , II, 1850, *Conus*, p 345, pl xii, fig 1
Conus geographus, Sowerby, Thes Conchyl , III, 1866, *Conus*, p 40, pl 23, fig 560
Conus (*Tulipae*) *geographus*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 396

A single, rather immature shell of this species from Krusadai Island is represented in the Museum collection, but Mr Crichton's collection contains a much larger and full-grown shell from Ceylon showing the typical adult colour markings and other features far more distinctly. This species is easily distinguished from most others recorded herein by the shell being comparatively thin, with a large, more or less inflated, elongately ovoid body whorl which has lost the cone-shape characteristic of the genus. The spire is moderately well raised, with its surface slightly concavely depressed and the apex sharply pointed The whorls are angularly shouldered, and the shoulders bear broad, compressed tubercles. The surface of the body whorl is smooth for the most part, but the basal part is faintly obliquely grooved in the young shell and the strong, transpiral growth striae are conspicuous in Mr Crichton's specimen The surface of the spire is finely spirally striated. The aperture is unusually broad, and much wider anteriorly, where the columellar border is markedly concave ; posteriorly, the outer lip is sinuate where it joins the body whorl The shell is whitish, faintly tinged throughout with a fine fleshy pink or pale blue, and irregularly marked all over with scattered, dark brown patches. The spire and apex tend to be tinged with a rosy hue.

[1] For an account of the venomous properties of the living animal of this species see *Trans. Roy Soc. Tropical Medicine and Hygiene*, XXXIX, 1946, No. 6, pp 486—512

In the young specimen, which was washed up on the beach on Krusadai Island, the shell is much thinner, the shoulders less sharply angular and less distinctly tuberculated, and the colour is much paler, the brownish markings tending to take a zig-zag form, somewhat as in the young of *Cypraea arabica.* This young shell measures 70 mm., while the adult shell from Ceylon measures 115 mm. in length. Krusadai Island.

Conus gubernator Hwass.

Plate XXI, fig. 2.

Conus gubernator, Hwass, Encyclopédie Méthodique, Vers, I, pt. 2, 1792, p 727, pl. 340.
Conus gubernator, Reeve, Conch Icon , I, 1843, *Conus*, pl xii, fig. 59.

A single shell from Pamban is contained in Mr. Crichton's collection ; it is frequently sold as an ornamental shell at Rameswaram ; the species has been definitely recorded from Ceylon. The shell is thick, solid, with an elongated and rather inflated body whorl bearing at its upper part a very strongly angular, and even raised and keel-like shoulder, which, however, is smooth and not coronated as in the preceding species. The spire is peculiar in many respects ; its sides are concave, and the lower part of its surface depressed, almost horizontal and on a level with the raised shoulder of the body whorl ; but the upper part of the spire is well raised and bears a sharply pointed apex; each whorl of the spire is strongly concavely depressed and bears a groove-like channel along the middle, and a raised, keel-like angulation at its lower edge resembling the shoulder of the body whorl. The surface of the shell is very finely spirally striated throughout, the striae being well marked chiefly on the dark-coloured parts. The aperture is elongated, narrower and less markedly widened below than in *C. geographus.* The cleft between the outer lip and the body whorl at the posterior end is very deep. The shell is whitish, slightly tinged with a pale brownish pink and very conspicuously marked all over with irregular black or blackish brown interrupted patches which tend to be disposed in the form of broken longitudinal bands, but towards the columellar border the blackish patches are more extensive and coalesce to form irregular islets of the ground colour clouded with a pale ashy blue. Pamban.

Conus marmoreus Linné.

Plate XXI, fig. 1.

Conus marmoreus, Linné, Syst Nat., Ed. X, 1758, p 172, No 250
Conus marmoreus, Reeve, Conch Icon., I, 1843, *Conus*, pl. xiv, fig 74.
Conus marmoreus, Kiener, Coq. Viv., II, 1846, *Conus*, p 4, pl ii, fig 1.
Conus marmoreus, Sowerby, Thes. Conchyl., III, 1866, p 2, pl. i, fig. 5.
Conus marmoreus, Tryon, Man Conch., VI, 1890, p 7, pl i, fig. 1
Conus (*Marmorei*) *marmoreus*, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p. 377.

A single shell from Pamban, slightly smaller and more perfectly conical than indicated by Reeve's figure of this species, is represented in the Museum collection, but there is also

another exactly similar shell from Ceylon in Mr. Crichton's collection, mislabelled as *C. omaria*, and which is correctly referable to the present species. The shell is moderately large, thick, strictly conical and straight-sided with an elongate body whorl and more or less depressed spire, the lower whorls of which are rather strongly flattened and almost on a level with the upper angular edge of the body whorl; the apex, however, is slightly raised, but very blunt and obtuse. The whorls are angularly shouldered, and the shoulders bear raised, bluntly angular tubercles which have become worn away in the upper whorls of the spire in the specimens examined The surfaces of the whorls of the spire are concavely channelled, while the entire surface of the shell is closely and uniformly spirally grooved. The aperture is narrow, elongated and almost perfectly parallel-sided, but the columellar border is feebly concave anteriorly The outer lip is separated from the body whorl by a fairly deep, angular cleft posteriorly. The shell bears a very boldly marked and attractive colour pattern consisting of a rather open network of blackish brown enclosing large, evenly spread out, triangular islets of the white ground colour. The whorls of the spire are prettily marked with dark brown transpiral bars alternating with large, white patches. Pamban.

Conus araneosus Hwass.

Plate XXI, fig, 3.

Conus araneosus, Hwass, Encyclopédie, Méthodique, Vers, I, pt. 2, 1792, p 612.
Conus araneosus, Lamarck, Anim. sans vert, VII, 1822, p 444.
Conus araneosus, Reeve, Conch. Icon, I, 1843, *Conus*, pl VIII, fig 44.

This species is reported to be common at Ceylon whence numerous shells are frequently obtained to be sold as ornamental paper weights. There is, however, in Mr. Crichton's collection a single shell from Pamban where it is comparatively rare. The shell is large, very thick, solid and heavy, with a broadly conical, straight-sided body whorl and a more or less feebly elevated spire with concavely depressed whorls and blunt apex. The body whorl is somewhat sharply angulated towards its upper end, the portion of the whorl above this angulation being almost horizontal or even concave, and almost on a level with the lower whorls of the spire. This angular shoulder and the angularly raised bottom of each whorl of the spire are coronated, being beset with raised tubercles, but these are often rubbed down in worn shells The surface of the shell is smooth throughout, except for the growth striae and a slight spiral grooving towards the base, and is even slightly glossy. The aperture is slightly broader than is usual in straight-sided cone shells and is wider below than above. The shell bears a characteristic colour pattern; it is whitish, tinged with a pale fleshy pink, and marked throughout with very fine, hair-like brownish lines which reticulate closely, but rather irregularly, the reticulations being generally disposed in longitudinal bands of alternately close and more open networks; in addition to this, there are two or three broad,

interrupted, blackish brown spiral bands on the body whorl. The interior of the aperture is white, tinged with violet. Pamban.

Family TEREBRIDAE.

The shell is generally slender and elongate, with a tall spire bearing numerous whorls, and a comparatively small body whorl, with a narrow base, either spirally striated or swollen and produced into a somewhat thickened columellar projection. The aperture is devoid of a well defined canal. The operculum is oval, with terminal nucleus and pointed extremity. The eyes are placed at the tips of the tentacles. The foot is small. This family includes the auger shells.

Two genera, *Terebra* and *Duplicaria* are represented at Pamban, each by a single species. In *Duplicaria*, the surface of the shell is usually glossy and the whorls are divided into two portions—an upper narrow part and a lower, much wider one—by a well marked spiral groove. In *Terebra*, on the other hand, the surface of the shell is much less glossy and the whorls are traversed by a number of spiral striae, which, however, are sometimes completely obscured.

Genus **Duplicaria** Dall, 1908

(Syn **Diplomeriza** *Dall*, 1919)

The shell is tower-shaped, and more or less straight-sided, the whorls being scarcely inflated, with thick, flattened, transpiral ribs and a spiral groove near the middle. The outer lip is somewhat broadened behind the base. The head is without tentacles or eyes.

Duplicaria duplicata (Linné).

Plate XXI, fig. 5.

Buccinum duplicatum, Linné, Syst Nat, Ed XII, 1767, p 1206.
Terebra lamarckii, Kiener, Coq. Viv., 1838, *Terebra*, p 30
Trebera duplicata, Reeve, Conch Icon, XII, 1860, *Terebra*, pl i, fig. 3.
Terebra duplicata, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p 141.
Duplicaria duplicata, Gravely, Bull Mad Govt Mus (Nat. Hist.), V, No. 2, 1942, p 80

This species is represented in the collection by a few, slightly worn, dead shells from Krusadai. The shell is very tall and slender with numerous uninflated whorls forming a narrowly elongate, straight-sided cone The spiral groove dividing each whorl is well marked, as deep as the suture itself, and is placed slightly above the middle of each whorl. The part above the groove is about one-third as broad as the part below it; the surface of both these parts bears flattened, transpiral ribs (which are often sharply and angularly raised in the upper whorls), and separated by fine, thread-like grooves. The aperture is

very small compared with the size of the shell, short and ovate. The outer lip is broken far back in most specimens taken on the beach, much as in the case of *Terebralia palustris* ; but a few shells in Mr. Crichton's collection have their outer lips entire ; the edge of the outer lip is thin and more or less straight The anterior canal is short and slightly twisted. The surface of the shell is glossy and pale brownish, with scattered, darker rusty brown, transpirally elongate markings, and often also with a broad, whitish or pale-coloured spiral band immediately above each suture. The largest Krusadai specimen in the collection measures 71 mm. in length and 14 mm. in maximum width. Pamban and Krusadai Island.

Genus **Terebra** Bruguière, 1792.

The shell is tower-shaped, with more or less numerous, variously sculptured whorls. The eyes are situated at the tips of the short tentacles. A radula is wanting.

Terebra subulata (Linné).

Plate XXI, fig. 4.

Buccinum subulatum, Linné, Syst Nat , Ed XII, 1767, p 1205
Terebra subulata, Kiener, Coq Viv , IX, 1838, *Terebra*, p 10, pl iv, fig. 6.
Terebra subulata, Sowerby, Thes. Conchyl , I, 1847, p 151, pl. 41, fig 16 , pl 42, figs 38 and 39
Terebra subulata, Reeve, Conch. Icon , XII, 1860, *Terebra*, pl vi, fig 22
Terebra subulata, Tryon, Man Conch , VII, 1891, p 10, pl 1, fig 3
Terebra subulata, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p 366.

A single, large and fine specimen of this species, measuring 6 3 inches in length is contained in Mr. Crichton's collection The shell is somewhat thick and heavy, and is enormously elongated. There are numerous whorls (about twenty-four in all), arranged in a gradually diminishing series from below upwards ; the apex is sharply pointed and terminates the greatly attenuated apical part of the spire , the walls of the whorls are scarcely inflated, the whorls being more or less straight-sided ; the sutures are strongly impressed The surface of the shell is practically smooth, but on close examination, fine, obliquely transpiral growth striae are distinctly seen ; in addition to these, the surface bears weakly developed, irregularly spaced spiral grooves ; one of these grooves, a little below the suture is slightly more strongly marked than the rest, but does not attain the depth and distinctness of the median spiral groove of *Duplicaria*. The outer lip is unfortunately broken far back in the only specimen available. The anterior canal is slightly twisted and the columella bears an oblique ridge. The shell is pale yellowish or cream-coloured, with a very boldly marked pattern consisting of a number of large, dark brown, squarish spots arranged in more or less regular spiral rows, of which there are two on each whorl of the spire, and one more on the body whorl. Krusadai Island.

Sub-Class OPISTHOBRANCHIA.

Order Pleurocoela (= Tectibranchia).

SERIES BULLOMORPHA.

Family ACTEONIDAE.

The shell is spiral, usually with a raised, conical spire, the whorls of which are few in number and bear a fine spiral sculpture. The aperture is narrowed above ; the columellar lip as a rule bears one or two folds. The foot carries a horny operculum. The animal is capable of complete retraction within the shell.

A single species, also known from the Madras area, and belonging to the genus *Pupa*, has been recorded.

Genus **Pupa** (Bolten) Roding, 1798.

(Syn. **Solidula** Fischer von Waldheim, 1807).

The shell usually bears a spiral sculpture; the spire is moderately short and the body whorl ovoid. The aperture is elongated, narrow above; the columellar fold is strong and double.

Pupa solidula (Linné).

Plate XXI, figs. 6*a* and 6*b*.

Bulla solidula, Linné, Syst Nat, Ed. X, 1758, p 728, No 346.
Tornatella solidula, Kiener, Coq. Viv, IX, 1834, *Tornatella*, p 4, pl 1, fig 2
Tornatella solidula, Reeve, Conch Icon, XV, 1865, *Tornatella*, pl 1, fig. 3
Solidula solidula, Pilsbry, Tryon's Man Conch., XV, 1894, p 142, pl 20*a*, figs. 37, 38, 44 and 45
Solidula solidula, Schepman, Siboga-Expeditie, Prosobranchia, Monogr. XLIX, 1908, p 460.
Pupa solidula, Gravely, Bull. Mad Govt Mus. (Nat Hist), V, No. 2, 1942, p 83.

Three specimens, a full grown shell from Krusadai Island and two young shells from Pamban, are represented in the collection. The shell is moderately large, measuring about 1·5 cm. in length, and more or less broadly and ovately spindle-shaped. The spire is short and conical with about three or four whorls indistinctly separated from one another, and a sharply pointed apex The surface of the shell is traversed throughout by strongly impressed spiral grooves separating slightly raised, close-set, spiral ridges ; the grooves are distinctly seen to be transpirally striated, these striae giving a more or less strongly punctured appearance to the grooves under the lens. The aperture is elongated, very strongly narrowed posteriorly but moderatley wide below, and its margin is unbroken by canals. The edge of the outer lip is very thin. The columella bears a strong, oblique fold which is rendered conspicuously double by the presence of a well defined median groove. The interior of the aperture is white ; while the outer surface is whitish or pale straw-coloured, marked uniformly

with regular spiral rows of greenish black spots which are confined to the raised interstitial portions of the surface between the spiral grooves.

The young shells are much thinner, paler and more narrowly spindle-shaped ; the spiral grooves and rows of spots are also much less distinct than in the adult shell.

Pamban and Krusadai Island.

Family HYDATINIDAE.

The shell is broadly ovoid, very thin and fragile, with closely adherent periostracum and broad, brightly coloured spiral bands. The surface is smooth, or with fine, very weakly developed spiral sculpture. The spire is small and more or less invaginated into the body whorl. The aperture is broad. The animal is capable of drawing itself into the shell.

A single species belonging to the genus *Hydatina* is represented at Pamban.

Genus **Hydatina** Schumacher, 1817.

The shell is smooth with a depressed or scarcely raised spire, coloured spiral bands and a wide aperture.

Hydatina velum (Gmelin).

Plate XXI, figs. 7*a* and 7*b*.

Bulla velum, Gmelin, Syst Nat., Ed. XIII,, 1791, p. 3433
Bulla vexillum, Adams & Reeve, Zoology of the " Samarang ", 1850, Mollusca, p. 65, pl. xix, fig 4.
Vexillum nigritarum, etc , Chemnitz, Conch Cab , X, 1788, p 144, pl. 146, figs 1348 and 1349.
Hydatina vexillum, Reeve, Conch Icon., XVI, 1868, *Hydatina*, pl. ii, fig 4.
Hydatina circulata, Hornell, Common Molluscs of South India, Mad. Fish Bull , XIV, 1921, p 142
Hydatina velum, Crichton, Journ Bomb. Nat Hist Soc., XLII, 1941, p 332.
Hydatina velum, Gravely, Bull. Mad Govt. Mus. (Nat. Hist), V, No 2, 1942, p. 84

This is the common Indian species of the genus, and is known also from Madras, where it is much better represented than at Pamban. Only a fragment of a shell of this species taken at Kundugal is represented in the collection. The shell is thin, fragile and seldom stands being washed up on the beach entire. The body whorl is ovoid and greatly inflated, while the spire is very much reduced and so strongly sunk inwards that its site is marked externally by a concave depression. The surface is smooth and even somewhat glossy, but the very fine, transpiral growth striae are distinctly seen under the lens The shell is of a very pale yellowish brown colour, marked with four brownish black spiral lines (which are sometimes slightly undulating) ; two of these occur at the middle, rather close together and enclosing a white band between them ; while, of the other two, one is at the top and the other at the bottom, each bounding a narrow white zone on the side away from the middle. As the specimen examined consists of a large fragment of the body whorl alone, the aperture

and the columella are entirely wanting in the specimen. But there are specimens in the collection with the soft parts intact, collected at Madras ; in these the foot is large with its antero-lateral corners somewhat elongated and pointed, while there are two large lateral lappets which can be extended over the shell during life. The head shield is large with two well developed lappets behind and a pair of spoon-shaped tentacles in front, with a rhinophore between them. Kundugal Point.

Family BULLIDAE.

The shell is moderately thick and broadly ovoid, with a large, inflated body whorl and a reduced spire which is deeply sunk in an umbiliform depression at the top. The surface is generally mottled and speckled with colour markings. The aperture is as long as the shell itself, and is broad in front, but somewhat narrowed posteriorly. The columellar margin is concave, without folds. The animal is retractile into the shell.

The single genus of the family, *Bulla,* is represented at Pamban by the only common species of the Indian shores, *Bulla ampulla,* which is also recorded from Madras.

Genus **Bulla** Linné, 1758.

(Syn. **Bullaria** Refinesque, 1815).

With the characters of the family.

Bulla ampulla Linné.

Plate XXI, figs. 8*a* and 8*b*.

Bulla ampulla, Linné, Syst. Nat., Ed X, 1758, p 727, No. 334.
Bulla ampulla, Adams, Thes. Conchyl., II, 1855, p. 575, pl. 122, figs. 59–62.
Bulla ampulla, Reeve, Conch Icon , XVI, 1868, *Bulla*, pl. 1, fig 3.
Bulla ampulla, Pilsbry, Tryon's Man. Conch., XV, 1895, p 343, pl. 34, figs. 1–3.
Bulla ampulla, Watson, " Challenger ", Zoology, XV, 1906, Gastropoda, p. 637.
Bulla ampulla, Schepman, Siboga-Expeditie, Prosobranchia, Monogr XLIX, 1908, p. 473.
Bulla ampulla, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 142.
Bullaria ampulla, Thiele, Handbuch der systematischen Weichtierkunde, I, 1931, p. 384
Bulla ampulla, Gravely, Bull. Mad Govt Mus. (Nat. Hist), V, No. 2, 1942, p. 84.

This is one of the commonest species of Tectibranchs represented at Krusadai, but so far only dead shells, which are frequently found plentifully washed up on the beach, have been collected. The shell is moderately thick and of considerable size, the largest shell in the collection measuring about 2 inches long and 1 5 inches wide. It is broadly ovoid, with a smooth and more or less polished surface, a large inflated body whorl, an inrolled spire deeply invaginated into a small, umbilicus-like cavity at the top, and an enormously elongate aperture extending throughout the length of the shell ; the aperture is very broad below, but considerably narrowed posteriorly. The outer lip extends a little above the level of the body whorl at the posterior end ; its margin is evenly rounded above and below,

but more or less straight medially. The columella is deeply concave below and is covered with a fairly thick, white, polished, callus deposit. The interior of the aperture is uniformly white, while the outer surface is of a characteristic mottled brownish colour, with irregular and ill defined, scattered, purplish brown blotches. Krusadai and Shingle Islands.

Family ATYIDAE.

The shell is of variable size in proportion to that of the animal, without projecting spire, and as a rule entirely external. The animal is sometimes capable of retracting completely into the shell, but sometimes it is larger than the latter and hence incapable of complete retraction. The foot bears well developed lateral lappets. The head shield is either notched or straight and truncated behind.

A single genus, *Haminoea*, also known from Madras, is recorded, but is represented by a different species at Pamban.

Genus **Haminoea** Turton, 1830.

[Syn. **Haminea** (Leach) Gray, 1847].

The shell is thin-walled, more or less elongately ovoid, with an inrolled spire, a wide aperture and a concave columellar lip, the latter bearing a thin callus layer, but without distinct folds. The animal is retractile within the shell.

Haminoea tenera (Adams).

Plate XXI, figs. 9*a* to 9*c*.

Bulla tenera, A Adams, Thes Conchyl , II, 1855, *Bulla*, sp. 75.
Haminoea tenera, Reeve, Conch Icon., XVI, 1868, *Haminoea*, pl. 1, fig 3.
Haminoea tenera, Gravely, Bull. Mad Govt. Mus (Nat Hist), V, No. 2, 1942, p. 84 (foot-note)

This species is well represented in the Pamban area, large numbers of specimens being frequently found living gregariously in company with those of *Nassa jacksoniana* and *Umbonium vestiarium* in weedy areas on the Kundugal mud flats; sometimes they are also found sticking to rocks on the reefs though they are as a rule much less abundant here. When collected alive, the shell is frequently seen to be entirely enveloped by the mantle. The shell is thin, fragile and rather small, measuring about 13 mm. high and 9 mm. broad on the average; it is not much unlike that of *Bulla ampulla* in shape and proportions. The spire is entirely sunk inwards into the body whorl, but unlike the preceding species, the pit marking its position is greatly reduced and almost completely obliterated externally. The aperture is elongated, wide below, but narrowed above. The outer lip extends a little above the level of the body whorl posteriorly. The columella is covered with a thin layer of callus and concavely arched below. The surface of the shell is smooth and covered by the mantle during life. The shell is somewhat translucent, and of a uniformly pale greenish white

colour. The foot is large and bears a flattened, expanded sole ; the animal is pale bluish green with pink spots during life. Krusadai Island and Kundugal Point.

SERIES APLYSIACEA.

Family APLYSIIDAE.

The shell is small, more or less completely covered over by the mantle, horny or calcareous, scarcely inflated and with a reduced or rudimentary spire. The head is without well defined shield and bears four flattened or cylindrical tentacles. Well developed parapodia are present ; they are directed upwards at the sides of the body. The sole of the foot is long and narrow.

The four genera represented at Pamban belong to four distinct sub-families, which may be distinguished as follows :—

1. Large molluscs, with very tough, warty and pigmented integument, not strongly contractile. Posterior end of body obliquely truncated and in the form of a large, rounded disc edged with a raised rim carrying papillae. Shell large, solid and calcareous, strongly concave, with a spire which is obliquely curved and heavily covered with callus, and a deep sinus or anal notch .. .. DOLABELLINAE.

— Animals generally slightly smaller or much smaller ; skin usually soft and either smooth or covered with fine warts or processes ; body generally flabby and strongly contractile ; posterior end of body not as above ; shell much thinner, membranous, and sometimes very much reduced or even absent altogether ; when present usually horny with a weak calcareous lining inside 2

2. Body rather large and humped, and contracting to the " sitting hare " position. Skin usually with reticulate markings, but without warts or villi. Rhinophores usually sticking out bearing a superficial resemblance to a hare's ears. Parapodia well developed, freely movable and functions as swimming organs. Shell large, but thin and membranous ... ... APLYSIINAE.

— Body smaller and usually broadly ovate, with a narrow head ; skin soft, with or without markings, but provided with small, contractile warts, papillae or villi. Parapodia small, not freely mobile, united posteriorly and not used for swimming ; shell thin, small and ridged, or absent altogether ... ...

3. Animal of variable size, generally moderately large, and usually considerably elevated dorsally. Shell entirely absent. Brightly coloured rounded spots known as ocelli usually present on clear areas of the skin. Skin provided with slender filamentous processes known as villi. Mantle cavity wide. Foot variable, sometimes with a long, pointed tail ... ... NOTARCHINAE.

— Animal small, creeping and slug-like ; body as a rule depressed. Shell present, but reduced, thin, rigid and aplysiiform. Skin soft, with or without markings, and usually bearing small contractile warts and papillae, but smooth in some. Mantle cavity reduced. Posterior portion of foot rounded, without a tail ... ... DOLABRIFERINAE.

Sub-family APLYSIINAE.

Genus **Aplysia** Linné, 1767.

(Syn. **Tethys** Linné, 1758).

The shell bears internally a feebly developed calcareous layer and is almost as large as the mantle ; it is inflated externally and has the small posterior projection produced into a curved plate. The animal is often large, with the posterior tentacles placed somewhat midway between the front end of the parapodia and the anterior tentacles. This genus includes the animals popularly known as the sea hares.

Three species of *Aplysia* have been recorded from Krusadai ; they may be distinguished as follows :—

1. Animal rather small, narrow and elongate, with a very narrow tapering tail ; posterior pair of tentacles very slender ; shell small, narrow and elongate ; sole of foot almost entirely smooth. *A. lineolata.*

— Animal much larger, broader and more rounded or ovoid ; tail considerably shorter and blunter ; posterior pair of tentacles stouter ; shell moderately large, rounded or ovate ; sole of foot frequently bearing glandular swellings 2

2. Animal with a characteristic colour pattern of large, blackish ocellate spots as well as a fine, loose network of blackish lines on a pale greenish ground colour ; glandular swellings on sole of foot large and coarse ; parapodia large and closing more fully over the dorsum ; posterior tentacles fairly large and moderately widely separated ; common ... ... *A. beneaicti.*

— Animal without the characteristic colour pattern described above; more or less uniformly greyish or greenish brown, but with fine reticulate markings; glandular swellings on sole of foot smaller, much finer, and more or less in the form of fine, longitudinally extending wrinkles; parapodia somewhat smaller and closing much less completely over the dorsum; posterior tentacles small, stubby and placed closer together; rarer ... ... *A. cornigera.*

Aplysia benedicti Eliot.

Plate XXII.

Aplysia (Tethys) benedicti, Eliot, "Notes on Tectibranchs and Naked Molluscs from Samosa", Proc. Acad. Nat. Sciences of Philadelphia, 1899, pp. 513–515, pl. xix, figs. 2*a* and *b*.

Aplysia benedicti, Bergh, Siboga-Expeditie, Opisthobranchiata, Monogr. XXV, 1905, p. 6, pl. vi, figs. 17–24.

This species is referred to as *Tethys benedicti* in the earlier list of Krusadai Mollusca. The animal is moderately large, measuring about 8 to 12 cm. long, 4 to 6 cm. broad and 5 to 6 cm. high on the average, but young specimens, which are sometimes found occurring gregariously in large numbers, measure much less. The body is soft, fleshy and more or less elongately ovoid; posteriorly the body is produced into a short, tapering tail. The skin is smooth, without warts or processes. The tentacles are large and leaf-like, while the rhinophores (posterior pair of tentacles) are more or less cylindrical and deeply cleft at the extremity. The parapodia are large and their thin edges are finely wrinkled. The mantle is thin and encloses the shell within it in a shell cavity. The shell is moderately large and ovate in outline, but very thin and almost completely membranous, bearing a very thin white, calcareous layer internally; it may be easily extracted from its cavity by cutting open the mantle which is about as large as the shell itself. There is a large, greenish grey ctenidium on the right side between the shell cavity and the parapodial fold and in front of the ctenidium is the small genital aperture. The jaws are very tough and leathery. The radula bears numerous teeth very closely set, the central teeth bearing three cusps. The foot is elongated, with a flattened sole bearing numerous glandular swellings. The ground colour is pale greenish, but the edges of the parapodia are tinged with pale blue, and there is a loose, irregular network of fine blackish lines all over the surface, as well as black, ocellate spots widely spaced especially over the sides of the body and parapodia. The inside of the parapodia is densely blotched with black. The animals are fairly common at Pamban and frequently inhabit soft sandy areas, though sometimes they may be found hiding in crevices of rocks on the reefs. They are capable of swimming actively. This species is said to appear abundantly only seasonally. Kundugal Point, Krusadai and Shingle Islands.

Aplysia cornigera Sowerby.[1]

Plate XXIII, figs. *1a* to *1f*.

Aplysia cornigera (?), Sowerby, in Reeve, Conch. Icon., XVII, 1870, *Aplysia*, pl. ix, fig. 40.
Aplysia orientalis (?), Sowerby, ibid., pl. v, fig. 18
Tethys cornigera, Pilsbry, in Tryon's Man. Conch., XVI, 1895, p. 102
Tethys orientalis, Pilsbry, ibid., p. 104 (Sowerby's description and figures repeated).
Aplysia cornigera, Farran, in Herdman, Ceylon Pearl Oyster Fisheries, Suppl. Report, Opisthobranchiata, III, 1905, p 349, pl. iv, figs. 2–7.
(Mr. Winckworth regards this record to have been based on wrong identification).
Aplysia cornigera, Eales, Proc Malac Soc, XXVI, 1944, p. 2

Two fairly full-grown and well preserved specimens from Krusadai Island are represented in the collection. The animal is moderately large, the larger of the two specimens measuring 95 mm. long, 52 mm. high and 49 mm. wide. It is rather elongated and ovoid, being narrow anteriorly and becoming broader behind ; posteriorly the body is produced into a short, thick, more or less bluntly rounded tail. The anterior tentacles are large, flattened and leaf-like, while the rhinophores are rather short, stubby and tubular with a terminal slit. The external surface of the rhinophores is strongly transversely grooved so as to appear annularly segmented. The parepodia are well developed, but are much shorter than in *A. benedicti*, and leave a considerable proportion of the mantle exposed above. The free edges of the mantle are finely wrinkled. The shell is rather large, broadly rounded in outline and conspicuously arched and beak-like towards its apex. It is thin, membranous and of a pale horny yellow colour and bears a thin calcareous layer closely adherent to it on its inner surface The ctenidium is large, well developed and bears dendritically branched lamellae ; it lies on the right side between the shell cavity and the parapodial fold. The spermatic groove running on the right side on the dorsum is very prominently developed. The foot is rather narrow and elongated with a flattened sole which bears fine, close-set, wrinkled, glandular swellings. Both the spirit-preserved specimens in the collection are more or less uniformly pale yellowish grey and have apparently lost their original colour.[2] This species is much rarer than the preceding one. Krusadai Island.

Aplysia lineolata Adams & Reeve.

Plate XXIII, fig. 2.

Aplysia lineolata, Adams & Reeve, Zoology of the " Samarang ", 1848, Mollusca, p. 63, pl xvii, fig 1.

A single specimen from Krusadai Island, measuring about 20 mm. long and 6 mm. broad has been somewhat doubtfully identified as *A. lineolata*. The animal is rather

[1] Mr. Winckworth considers that *Aplysia fimbriata* Adams & Reeve, recorded by Dr. Gravely from the Madras coast may be identical with the present species

[2] Miss Eales, in her paper on the Aplysiids from the Indian Ocean (*loc cit.*) describes the colouration of *Aplysia cornigera* as follows : " the heavily built body had fine reticulate markings arranged to give mottled areas alternating with clear spaces. In the centre of each reticulate area is a black spot " In the present preserved specimens, though no black spots are seen, some, at least, of the fine reticulate markings may be faintly distinguished.

narrow and elongate with a strongly narrowed, tapering caudal extremity. The sole of the foot is elongated, flattened and smooth. The head is rather narrow and bears as usual, two pairs of tentacles ; the anterior pair are flattened and leaf-like, but the posterior ones are very slender, though much contracted in the specimen examined. The shell which has been carefully extracted from the animal is preserved with it. It is small, very thin and membranous, with a thin layer of calcareous deposit on the inner side. The shell is proportionately somewhat narrower and more elongate than in *A. benedicti*. The only specimen available is uniformly pale brownish green, and has evidently lost most of its original colouration, for Adams & Reeve's figure shows a reticulation of black lines as well as small blackish spots bordered with blue. This species is considerably rarer than the preceding one. Krusadai Island.

Sub-family DOLABRIFERINAE.

Genus **Petalifera** Gray, 1847.

(Syn. **Aplysiella** P. Fischer, 1872).

The shell is thin, feebly inflated ; the mantle covers the shell only round the margin. The body is elongately ovate, moderately inflated, somewhat widened in the middle. The head is not distinctly marked off. The foot is very broad, bears parapodia and is narrowed behind.

A single species is recorded from Krusadai Island.

Petalifera krusadaiae O'Donoghue.

Plate XXIII, figs. 3*a* to 3*f*.

Petalifera krusadaiae, O'Donoghue, Proc. Malac. Soc , XIX, pt. iii, 1930, p. 88.

This species was described as new by Dr. O'Donoghue in the paper cited above, from a single specimen collected by Dr. Gravely on Krusadai Island. The preserved specimen measures 9 3 mm. long, 3 5 mm broad and 2 mm. high at its thickest part. The animal is broad and somewhat flattened, with the head and neck not distinctly marked off from the body. The parapodia are well developed and are united behind. Anteriorly they are divided merely by a narrow seminal groove. The dorsum is smooth, but beset with a few simple papillae. There are two pairs of tentacles—the cephalic ones and the rhinophores ; both are cylindrical, but the latter have wrinkled sides and bear the minute black eyes just in front of their bases. The foot is well developed, narrowed behind into a tail, while anteriorly it is broadly rounded ; it bears a well marked flange all round. The ctenidium is single, lies on the right side of the body, and consists of a median rachis flanked on either side by fleshy respiratory lamellae. The gill and the anal cone are more or less exposed above.

The genital opening is a minute aperture on the right side just in front of the point of origin of the ctenidial rachis. The shell is relatively large, but extremely fragile and almost entirely membranous without any trace of calcification ; it is broad, ovate, but without posterior indentation, thus assigning the position of the present species in the sub-genus *Pseudaplysia.* The buccal tube is furnished with a pair of thickened plates one on each side. The radula is spear-head-shaped and bears 31 rows of teeth The type specimen of this species was obtained from the Indian Museum for examination ; it is rather contracted, and of a uniformly pale yellowish grey colour, with no indications of colour markings. Krusadai Island.

Sub-family DOLABELLINAE.

The single genus of this sub-family is represented by the well known species, *D. rumphii*, which is widely distributed in the Indo-Pacific region.

Genus **Dolabella** Lamarck, 1801.

The shell is comparatively thick, calcareous, flattened, spiral, with the apex covered and thickened by a callus deposit, sometimes with a calcareous lamella, and with the right margin strongly concave. The body is broad behind, but narrowed anteriorly. The parapodia are divided in front only by the genital groove.

Dolabella rumphii Cuvier.

(Syn. **Dolabella scapula** Martyn).

Plate XXIV.

Dolabella rumphii, Cuvier, Ann du Mus , V, 1804, p. 437, pl xxix, fig 1
Dolabella rumphii, Rang, Ann du Mus., 1828, p 46, pl. 1
Dolabella rumphii, Reeve, Conch. Icon , XVI, 1868, *Dolabella*, pl 1, fig. 3.
Dolabella rumphii, Adams & Reeve, Zoology of the " Samarang ", 1850, Mollusca, p. 65.
Dolabella rumphii, Bergh, Siboga-Expeditie, Opisthobranchiata, Monogr. XXV, 1905, p. 13, pl.vii, figs. 22—40 ; pl. viii, figs. 1—7

Several large living specimens of this species have been collected from the Krusadai Island area, particularly on the Kundugal mud flats where these animals are sometimes seen lying in pairs or small groups in little, muddy puddles of water. The animal is very large, measuring on the average about 16 cm. long, 10·5 cm broad at its widest part and about 6 to 8 cm. high The body is broad and elongated, with a more or less oblong outline, but much broader behind than in front where it is narrowed considerably. The posterior part of the animal is very distinctly marked off as a broad, obliquely truncated disc, bordered by a raised fringe of the integument. The skin is very rough, much tougher and firmer than in *Aplysia* and bears numerous short, filamentous processes scattered all over, and many of which are mounted on tubercle-like swellings. The head is more or less globular and divided ventrally by a deep depression from the foot. The anterior tentacles are flattened and broadly expanded. The rhinophores are more or less cylindrical, with a wrinkled and

papillated surface, and are hollowed at their distal extremities. The foot is very broad, with an almost perfectly smooth, flattened sole. The parapodial folds are well developed and are united in front, the line of junction between them being indicated by the fine spermatic groove which starts at about the middle of the entire length of the body and runs anteriorly, turning to the right side of the head. Behind the origin of this groove, the edges of the parapodia touch one another, but are not united in the region of the mantle where they form a narrow dorsal slit with two wide ovate openings, one anteriorly above the ctenidium and the other behind, over the exhalent siphon. The genital opening is beneath the gill, about the middle. The buccal tube is about 10 mm. long and is furnished with two horny brownish jaws. The radula bears numerous close-set teeth, but the rows are rather widely spaced. Each tooth consists of a narrow basal plate with one long thin cusp. No central tooth or space is distinguishable. The shell is white, strong, calcareous, hatchet-shaped, covered with a thin yellowish brown horny membrane but the apex of the spiral is covered by a thick callus deposit, and lies somewhat to the right of the middle, partly covered over by the mantle. The shell being much thicker and stronger than that of *Aplysia*, survives being washed up on the beach. The animal is more or less uniformly dark olive-greenish, irregularly marked here and there with blackish or arenaceous markings. It is generally very sluggish in its movements, and when irritated ejects a copious quantity of a dark purplish fluid. Kundugal Point and Krusadai Island.

Sub-family NOTARCHINAE.

Genus **Bursatella** de Blainville, 1817.

The body is soft and broad, with a short, triangular tail, the greatest height and breadth being somewhat behind the middle. The skin is covered all over with simple and compound villi. The skin also bears rounded spots—the ocelli. The foot is rather broad with bilabiate anterior margin. The parapodia are rather short and thick and fused posteriorly. The mantle is small, but the mantle cavity is wide. A shell is absent.

This genus includes a single species, *Bursatella leachii*, which is represented in the collection by a few specimens dredged off Krusadai Island, but it is much more abundantly represented at Ennur, where numerous specimens have been collected.

Bursatella leachii de Blainville.

Plate XXV, figs. *1a* to *1d*.

Bursatella leachii, de Blainville, Dict. Sci. Nat., V., 1817, p. 138, and Manuel, Malacol., 1825, p. 473, pl. xlii. fig. 6.
Bursatella leachii, Rang., Hist. Nat. des Aplysiens, 1828, p. 78.
Notarchus, Hornell, Common Molluscs of South India, Mad. Fish. Bull., XIV, 1921, p. 145, fig. 32.
Bursatella leachii, Eales and Engel, Monograph on *Bursatella*, Proc. Malac. Soc., XXI, 1935, p. 296.
Bursatella leachii, Gravely, Bull. Mad. Govt. Mus. (Nat. Hist.), V, No. 2, 1942, p. 81.
Bursatella leachii, Eales, Proc. Malac. Soc., XXVI, 1944, p. 13.

The Krusadai specimens are all small and appear to be not full-grown, but there are numerous fine specimens in the collection from Ennur, measuring well over three inches in length. The body is soft and of a flabby consistency, and resembles somewhat an *Aplysia* in general form, but is readily distinguished from the latter by the presence of long, filamentous processes scattered all over the upper surface of the body. The larger of these villi are dendritically branched at their tips. The head bears two pairs of branched tentacles which, apart from their particularly large size appear much like the compound villi found on the rest of the surface. The oral lobes, anterior cephalic tentacles and the rhinophores all bear villi and the edges of the foot are also fringed with simple papillae. The parapodia are united posteriorly and not open as in *Aplysia*, leaving only a small aperture on the summit of the dorsal surface. This dorsal slit is narrow and short, but can become oval when dilated. The shell is absent altogether. The broad foot has a bifid anterior margin with lateral projections, and is produced behind into a short, triangular tail. The mantle is small, but the mantle cavity is wide and accommodates the large, single, arcuate ctenidium which is frequently seen projecting out of the dorsal slit. The anus is eight-lobed. The genital aperture is situated just within the dorsal slit. The radula contains 34 rows of teeth with a maximum formula of 40·140. The penis is short, thick and armed with spines set on muscular warts. The animal is greenish grey or brownish in life, and usually ornamented with beautiful eye-like rounded spots or ocelli, each with a green centre edged with a ring of pale orange. As in the case of *Aplysia*, the egg masses of *Bursatella* consist of gelatinous tangled cords filled with dirty reddish brown ova. Krusadai Island.

Order Sacoglossa.

Family POLYBRANCHIIDAE (= CALIPHYLLIDAE).

The animal is without shell and mantle, more or less strongly compressed, and with numerous leaf-like dorsal processes. The head bears a pair of anterior folds and bifurcated rhinophores. The foot is moderately broad in front.

A single genus and species are recorded.

Genus **Polybranchia** Pease, 1860.

(Syn. **Phyllobranchus** Alder & Hancock, 1866).

The body is elongate, flattened on the back and angulated at the sides. The rhinophores are dorsal and bifurcated above. The branchiae are leaf-like and arranged in rows. The anus is lateral.

Polybranchia orientatis (Kelaart).

Plate XXV, figs. 2*a* and 2*b*.

Proctonotus orientalis, Kelaart, Journ Roy. As. Soc. (Cey. Br.), 1858, p. 492.
Proctonotus orientalis, Kelaart, Ann Mag. Nat. Hist., ser. 3, III, 1859, p. 492.
Phyllobranchus orientalis, Alder & Hancock, Trans. Zool. Soc., London, V, 1866, p. 145, pl. 33, figs. 18 and 19.
Phyllobranchus rubicundus, Bergh, Siboga-Expeditie, Opisthobranchiata, Monogr. XXV, 1905, p. 77, pl. xiii, fig. 12.
Phyllobranchus orientalis, Eliot, Proc Zool. Soc. London, 1906, II, p. 639.
Phyllobranchus orientalis, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p. 142.

The specimen examined measures 20 mm. long, 5 mm. wide and 5·5 mm. high, and has been collected on Shingle Island. A label in Dr. Gravely's handwriting accompanying the specimen states that it is a "large, dull greenish nudibranch with cerata that stick to everything but their owner". The body is elongated with a somewhat flattened dorsal surface and angular dorso-lateral margins. The anterior tentacles are rather short, conical, folded on themselves and placed at the anterior extremity ; the rhinophores are long, cylindrical, longitudinally folded and deeply bifid at the free extremities; they are placed far forward, very close to the anterior pair. The cerata, or branchial appendages, are numerous, large, ovate and leaf-like and are disposed throughout the entire dorsal surface of the animal ; but they are easily detached (caducous), and in the present specimen, all except a few of the smallest in the front part of the body have become separated and are lying loose in the specimen bottle ; the points of their attachment, however, are clearly seen on the integument as small scars or tubercles ; each of the creata has a short, cylindrical peduncle and a large, foliaceous portion expanded into a flattened, ovate lamina, with a slightly concave surface and minutely toothed margin ; the surface shows vein-like radiating lines as in a leaf ; the largest of these measures about 6 mm. by 4 mm. Dr. O'Donoghue points out that while the cerata are, on the whole, irregularly arranged, yet their origins are confined to a distinct, rather narrow longitudinal band along the region of the junction of the dorsum and the sides of the body. The radula consists of a single row of 42 teeth. The head is inclined downwards and expanded laterally terminating in the folded anterior tentacles. The foot is broad, elongate, slightly arched truncated in front, but tapered to a fine point behind The animal is of a dull olive green colour. Both *P. prasinus* and *P. rubicundus* of Bergh are synonymous with the present species. Shingle Island.

[1] Specimens of this and the following Opisthobranch species contained in the collection of the Madras Museum have been examined by Dr. Chas O'Donoghue, who has made a report of them in his paper entitled "Notes on Nudibranchiata from Southern India", and published in the Proceedings of the Malacological Society, London, Vol. XX, Part iii, 1932 ; but the specimens of a few of the species described as new in his paper were later re-examined by Col. H. C. Winckworth who renamed them, referring them to already known species. The consequent discrepancies are duly pointed out in the course of the descriptions of the relevant species in the present paper. Our thanks are due to both these gentlemen for their valuable work on our Opisthobranchiate collections. I have found Dr. O'Donoghue's paper particularly helpful in preparing the following account.

Family ELYSIIDAE.

The body is devoid of dorsal appendages but is provided with lateral folds which are directed upwards. The head carries more or less large rhinophores and small eyes behind them. The pharynx bears a small crop. There are two vaginal openings on the right side.

A single genus, *Elysia*, is represented at Krusadai.

Genus **Elysia** Risso, 1818.

The head and foot are moderately small and the rhinophores usually grooved. The eyes are situated laterally. The lateral folds are more or less short and not strongly wrinkled. The dorsum is without longitudinal folds. The penis is devoid of a stylet.

Two species, *E. ornata* and *E. grandifolia*, are represented in the collection. In the former, the animal is comparatively small, with an outline which is more or less strictly ovate, narrowing equally in front and behind and the dorsum which is more darkly coloured towards the periphery, bears a number of fine black dots medially ; while in the latter, which is much larger, the body is broad in front, but tapers to a pointed tail behind, the dorsum is more or less uniformly pale-coloured without dots along the centre and there is an elongated pericardial prominence centrally.

Elysia grandifolia Kelaart.

Plate XXV, figs. 3*a* to 3*c*.

Elysia grandifolia, Kelaart, Journ. Roy. Asiat. Soc. (Cey Br), III, 1858, p. 493.
Elysia grandifolia, Eliot, Proc. Zool Soc. London, 1906, pt. ii, p. 689
Elysia grandifolia, Eliot, 'The Nudibranchs of Okhamandel ", Rep. to Govt. of Baroda on Marine Zoology, 1909, p. 144.
Elysia grandifolia, O'Donoghue, Proc. Malac. Soc., XX, pt iii, 1932, p. 141.

The single specimen represented in the collection is from Krusadai Island and measures 45 mm. long and 31 mm. wide, and Dr O'Donoghue reports that it is noticeably larger than any previously recorded The animal is flattened, leaf-like and more or less triangularly ovate, being broad in front and narrow behind, where it tapers to a long and pointed tail. The rhinophores are well developed and auriculate. The lateral wing-like expansions of the body are prominent. The mouth is situated ventrally. Along the centre of the back there is a distinct, elongated, ridge-like thickening; this is the pericardial prominence which is prolonged backwards and constricted at intervals; from either side of this there arise the main trunks which later branch and give rise to the vein-like reticulations characteristic of the species; it results in an elaborate, raised network on the upper surface of the body. The entire animal in the preserved condition is of a more or less uniformly dull yellowish grey colour ; but under the lens numerous fine, black dots are seen irregularly scattered all over the surface, the dots being more numerous on the ventral than on the dorsal surface ;

the upper and lower edges of the margin and the rhinophores are blackish. The radula is well developed and consists of a single row of teeth, 10 in the ascending and 21 in the descending series. Krusadai Island.

Elysia ornata (Pease).

Plate XXV, figs. 4*a* to 4*c*.

Pterogasteron ornata, Pease, Proc. Zool. Soc. London, XXVIII, 1860, p 36.
Elysia ornata, Bergh, Malac. Unters. Supplementheft, II, 1881, pp. 79 and 80, taf. G, fig. 18.
Elysia ornata, Bergh, Siboga-Expeditie, Opisthobranchiata, Monogr. XXV, 1905, p. 84, pl. ii, fig. 20.
Elysia ornata, Eliot, Proc. Zool. Soc. London, 1906, pt ii, pp 688 and 689

This species is represented in the collection by a single specimen collected on Krusadai Island. The animal is much smaller than that of the preceding species ; it is thin, flattened and leaf-like, with an elongately ovate profile and found crawling mostly on sea weeds. The body is smooth, with strongly undulating margin. The tentacles are grooved along their entire length and slightly truncated. The head, though small, is very distinct, protrudes far forwards and carries two moderately well developed rhinophores, each about a millimetre in length in the preserved condition. The colour of the specimen is badly faded. It is dull greyish on the periphery, and pale yellowish brown along the middle ; this central, pale-coloured area is marked with a number of blackish dots. Bergh's figure (pl. ii, fig. 20, *loc. cit*), gives a good idea of the colouration of this species in the live condition, when it is olive green, spotted with pale yellow and distinctly dotted with black. The body bears a marginal band of bright orange-red edged with black ; the upper surface of the body is paler than the lower. The length of the present specimen, which is rather badly contracted, is about 13 mm., but during life a length of over 20 mm. has been recorded. Krusadai Island.

Order Acoela.

Sub-Order Pleurobranchomorpha.

Family PLEUROBRANCHIDAE.

The shell is usually enveloped by the mantle, as a rule thin, with reduced spire and larger, somewhat inflated body whorl; the shell is sometimes absent altogether. The mantle is generally studded with calcareous spicules. The ctenidium is large, single and situated on the right side between the foot and the mantle.

The single species of this family recorded from the Pamban area belongs to the genus *Euselenops*. *Euselenops* Pilsbry, 1896, is treated by Thiele as a sub-genus under the genus *Pleurobranchaea* Leue, 1813, but as the characters of *Euselenops* are sufficiently distinctive it may, with propriety, be separated as a distinct genus.

Genus **Euselenops** Pilsbry, 1896.

The animal is without a shell ; the mantle is continuous with the velum. The rhinophores are situated laterally in the notch between the margins of the velum and the mantle. The sole of the foot is smooth and without glandular swellings. The velum is very broad and the gill rachis is tuberculated.

Euselenops winckworthi Satyamurti.

Plates XXVI, XXVII and XXVIII.

Euselenops winckworthi, Satyamurti, Proc Malac. Soc., XXVII, pt. ii, 1946, pp. 76—83.

A moderately large specimen which I collected on the mud flats at Kundugal Point between tide marks appeared to belonged to an undescribed species of *Euselenops,* and in token of my gratitude to Col. H. C. Winckworth for his kind help and encouragement, I have named it after him. A detailed report of the species has already been communicated to the Malacological Society of London. The present species differs from the known species of *Euselenops* reported in Vayssière's " Monograph on the Pleurobranchides " (*Ann. Sci. Nat.*, XII, 1901) not only in its colour and dimensions but also in the proportions of its various parts and the arrangement of the jaw elements and nature of the radular teeth.

The animal is broadly ovate in outline, and strongly dorso-ventrally compressed, the dorsum and the ventral sole of the foot being almost perfectly flattened. Anteriorly there is a very broad velum which is strongly curved in front. The ventral surface and anterior edge of the velum bear numerous, close-set, fine, short, filamentous processes which are longer and thicker posteriorly, but get shorter, thinner and more numerous towards the anterior border ; these processes bear fine projections on their anterior face, while their posterior face is smooth. The velum terminates on each side in an angular lateral expansion. The mantle is relatively small and broadly ovate in profile ; anteriorly it is continuous with the velum, but the junction between the two is marked by a distinct, slit-like indentation. The rhinophores are moderately short, somewhat flattened, fleshy lobes, rolled upon themselves to form broadly conical structures, and are inserted laterally in the indentation between the mantle and velar margins. The surface of the rhinophores is smooth, and the edges of the inrolled folds are separated by a vertical slit posteriorly. The dorsum is practically smooth, but fine, reticulated, groove-like depressions are distinctly seen under the lens. The buccal funnel is large, distinctly marked off from the body and is placed below the velum. The foot is very large, rounded, shield-shaped, smooth and bears a broad, flattened sole ; a considerable proportion of the peripheral part of its dorsal surface is exposed above, being left uncovered by the relatively small mantle. The margin of the foot is well defined, entire and broadly rounded behind ; fine obliquely decussating muscle fibers are clearly seen traversing the texture of the foot. The sole of the foot is smooth, without glandular swellings. The

mouth is a small, vertically elliptical slit, placed at the anterior extremity of the buccal mass. There is no shell. There is a single, moderately large ctenidium on the right side, lying in the space between the foot and the mantle, and more or less hidden by the mantle in a view from above. It is plume-sheped, bipectinate, with a median rachis and a row of about 34 gill lamellae on each side ; the gill rachis is distinctly tuberculated, the number of tubercles being about the same as that of the lamellae. The gill is attached by its ventral edge almost throughout its entire length, except for a short distance posteriorly, where it is free. Immediately to the left of the ventral attachment of the gill and at a level about just in front of its middle, lies the anus, which appears as a small, but well defined circular aperture ; and in front of the anterior extremity of the gill is a larger aperture, which is the opening of the prebranchial sac. The penis is large, voluminous, somewhat cylindrically swollen and lies in front of the ctenidium, projecting obliquely backwards ; its terminal portion is seen from above protruding beyond the level of the mantle ; its surface is strongly tuberculated. The labial armature consists of two thin, pale horny yellow jaw plates ; they are broad anteriorly, but get gradually narrowed behind. They consist of an enormous number of minute, flat, closely packed, scale-like platelets which constitute the jaw elements ; they differ in shape in various parts of the jaw, being either oblong, squarish, rhomboidal, irregularly polygonal or in the form of large open hexagons. The radula is large and well developed and of a pale horny yellowish brown colour. It is broad and elongated and measures 11·6 mm. long and 5·5 mm. wide at its broadest part. It consists of 74 rows of teeth on either side of a toothless rachis. There are about 250—260 teeth on each side in a fully formed row. Each tooth consists of a broad base bearing an elongated, gradually curved blade tapering towards and pointed at the tip, and bearing a short, downwardly recurved, hook-like protuberence just a little above the base. The animal is almost uniformly translucent white, very slightly tinged with pale yellow over the foot and with very pale fleshy pink on the mantle and greater part of the velum. The animal had no trace of colour markings even while it was collected alive. The medusoid, jelly-like appearance of the integument renders some of the internal organs partially visible in an external view. The measurements of the preserved specimen are as follows :—length of body, 60 mm. ; width of body, 47 mm ; thickness of body, 10 mm. , length of rhinophores, 8 mm ; length of mantle, 26 mm. ; width of mantle, 24 mm ; width of velum from tip to tip, 52 mm. ; length of penis, 13 mm. ; length of gill, 16 mm. ; width of gill at the middle, 6 mm. ; length of pharynx, 15 mm. ; width of pharynx, 11 mm.

The genus *Euselenops* has been represented so far only by two known species, *E. luniceps* and *E. pleurobranchaeana* ; of these the former is by far the more widely distributed and better known, and has been recorded from Madras ; the present species appears far more closely related to this species than to *E. pleurobranchaeana* which is more like a *Pleurobranchaea*.

Kundugal Point.

Sub-Order Nudibranchia.

The Nudibranchia are naked marine Mollusca without a shell in the adult state; they are generally carnivorous, brightly coloured and externally symmetrical. The ctenidium, which is the usual respiratory organ of the Gastropoda, is replaced in these forms by variously branched appendages known as secondary branchiae, developed from the dorsal integument and serving the respiratory function. This sub-order comprises numerous families of which a few are fairly well represented at Krusadai and Pamban.

As the following account is based mainly on a study of specimens that have been long preserved in alcohol and have consequently become faded and contracted to a varying degree, it has been found difficult to make it as completely descriptive as those of the other groups dealt with in this paper. It is therefore much to be desired that field workers make careful observations of the natural colours and shapes of these beautiful animals in their living condition and compare them with the remarkably well produced coloured sketches in works such as Alder and Hancock's Monograph on "Indian Nudibranchiate Mollusca" (*Trans. Zool. Soc. London*, V, 1856), Bergh's "Opisthobranchiata of the Siboga Expedition" and Sir Charles Eliot's paper on the "Nudibranchs of Southern India and Ceylon" *Proc. Zool. Soc. London*, 1906, II).

SERIES DORIDACEA.

Family TRITONIIDAE (= DUVAUCELIIDAE).

The body is elongated, usually with branchial processes on the sides of the dorsal surface; the head-shield is large and usually bears processes; the pharynx is large, with strong lateral jaws. The anus is situated on the right side.

A single genus, *Marionia*, is represented.

Genus **Marionia** Vayssière, 1877.

The body is four-sided, with prominent head-shield; the margin of this shield bears processes which are branched at their tips. The edge of the rhinophores is devoid of processes. The stomach contains numerous rough plates.

The specimen which was referred to as *Marionia arborescens* Bergh, in the previous list of Krusadai Mollusca [*Bull. Mad. Govt. Mus.* (Nat. Hist.), I, No. 1, 1927, p. 101], has been later re-identified as *M. pambanensis* by Dr. O'Donoghue, and reported as such in his paper cited above.

Marionia pambanensis O'Donoghue.

Plate XXIX, figs. 1*a* to 1*h*.

Marionia pambanensis, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p. 152.

The type specimen of this species which was obtained for examination from the Indian Museum is in a good state of preservation and was taken at Pamban bridge in the Gulf of

Manaar. It measures 22 mm. long, 12 mm. wide and 7 mm. high. The body is rather flattened but distinctly rectangular in transverse section; at the posterior end it tapers into a somewhat pointed tail. The dorsum is flattened and bears numerous small, rounded tubercles; the dorsal surface bears a row of branchial appendages on each side. Anteriorly the body passes into a feebly bilobed cephalic shield which bears six digitiform processes on each side of the middle line. The lateral margin of the shield is thickened. The head is sub-globular and entirely covered over by the cephalic veil. The mouth is an elongated slit at the front extremity of the head. The foot is elongated, well developed, of about the same length and width as the dorsum, and distinctly marked off from the sides by an angular flange; its anterior end is rounded and thickened, while posteriorly it is narrowed and pointed. The rhinophores are retractile into erect, tubular sheaths. The branchiae consist of a series of about twelve pairs of dendritically branched processes borne on a lateral flange on the dorsum; of these branchiae only seven pairs are conspicuous in the present specimen. Both the reproductive opening and the anus lie on the right side of the body, the latter being placed behind the former; on the integument, below the third branchial tuft, lies the crescentic reproductive aperture bounded by well marked lips. The buccal mass is large; the lips are lined with a thin layer of chitin; the jaws are stout and oval in outline. The radula is well developed and, flattened on a slide, measures 3·25 mm. long and 2·75 mm. wide. It contains 40 rows of teeth. The stomach is provided with a large number of hard chitinous plates as is usual in the genus. The preserved specimen is dark dirty greenish grey all over, with no sign of any definite colour markings; the specimen has apparently contracted slightly since Dr. O'Donoghue's examination. Pamban.

Family DORIDIDAE.

The body usually bears a more or less broad dorsum; the upper surface is smooth, warty or tufted. The branchiae are almost always placed in a pouch into which they can be completely retracted. The dorsal tentacles are retractile into cavities. The mantle is large and spiculose. The oral tentacles are variously shaped or sometimes wanting. The mouth bears a denticulated prehensile tongue and occasionally a spinuous collar.

The Krusadai species of this family belong to four different sub-families, the distinguishing features of which are outlined in the following analysis and diagnostic key:—

Glossodoridinae.	Archidoridinae.	Discodoridinae.	Asteronotinae.
Lips armed with hooks; without prostate; penis feebly developed and as a rule unarmed. Radula sometimes with a central plate or spine; other plates short and toothed.	Lips usually unarmed; radular plate hatchet-shaped, smooth; without prostate; penis with glans; seminal vesicle with one or two ducts.	Lips naked; radula plates hatchet-shaped; prostate strongly developed; penis with glans; seminal vesicle with one or two ducts.	Lips without hooks; prostate strong; radular plates hook-shaped, the outer ones of which are sometimes toothed; penis with or without glans, unarmed; seminal vesicle with two ducts.

Key to the sub-families :—

1. Lips armed with small hooks ; body usually smooth. Radula generally with the central plate rudimentary or absent, and with numerous, as a rule toothed lateral plates. Prostate absent. Penis feebly developed and as a rule unarmed ... ... *Glossodoridinae.*

— Lips naked and not armed with hooks ; radular plates well developed and hook-shaped ; prostate either absent, or, when present, strongly developed. Penis strongly developed and generally with a glans ... 2.

2. Animal without prostate ; body generally soft and dorsum covered with tufts of warty processes. Radular plates hook-shaped or hamate, smooth. Anterior margin of the foot often united with the head by a fold ... ... *Archidoridinae.*

— Animal with the prostate strongly developed ; body generally harder and firmer ; the dorsum is either covered throughout with fine tubercles or with a network of ridges ; radular plates hook-shaped, but generally sharply toothed. Anterior margin of foot free ... ... 3.

3. Dorsum generally covered uniformly with fine, hard, papilla-like tubercles, with somewhat pointed tips which may sometimes be filamentous. Lips naked or with fine rodlets. Anterior margin of foot usually distinctly cleft ... ... *Discodoridinae.*

— Dorsum sometimes smooth and slimy and sometimes bearing a network of ridges radiating from raised centres which may bear stylets or filaments. Lips always without armature. Anterior margin of foot generally entire ... ... *Asteronotinae.*

Sub-family GLOSSODORIDINAE.

A single species belonging to the genus *Glossodoris* has been recorded from Pamban.

Genus **Glossodoris** Ehrenberg, 1831.

(Syn. **Chromodoris** Alder & Hancock, 1855).

The body is usually smooth and brightly coloured, with the margin of the dorsum considerably thinned out; the mantle seldom bears spicules. The lips are armed with small hooks. The tentacles are small.

Glossodoris humberti (Kelaart).

Plate XXIX, figs. *2a* to *2h*.

Doris humberti, Kelaart, Journ. Roy. Asiat. Soc. (Cey. Br.), III, 1858, p. 694.
Doris humberti, Kelaart, Ann. Mag. Nat. Hist., ser. 4, IV, 1859, p. 268.
Glossodoris humberti, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p. 161.

The single specimen of this species represented in the collection was collected by Dr. Gravely at Pamban bridge in the Gulf of Manaar. The preserved specimen measures 16 mm. long and 8 mm. wide; the foot is 15·5 mm. long and 4·5 mm. high. The body is elongately ovate, with a wide, outstanding, more or less flattened and plate-like dorsum, which is oval but slightly broader in front than behind. The body proper is narrower than the dorsum, its lateral margins are almost vertical and its posterior end is tapered into a thin, pointed tail. The head is very small and placed almost concealed between the broad, flap-like, overhanging mantle above and the anterior end of the foot below; it is produced into small oral tentacles at the sides. The foot is narrow and elongated and is produced behind into a conspicuous, pointed tail which projects beyond the level of the posterior end of the dorsum and quite independant of it. The rhinophores (or dorsal tentacles) are laminated, but they are rather contracted and drawn deeply into their sheaths in the specimen examined. The branchiae are small, ten in number (though stated to be nine by Kelaart in his original description), irregularly pinnately branched and are placed in the form of a close circle in a pouch; they are tolerably extended in the present specimen. The anus is situated within the circlet of branchiae. The buccal mass is well developed and the lips are covered with a very thin disc of chitin which is invaginated inwards at the aperture of the mouth so as to form a lining for the first part of the buccal tube. The radula is long, narrow and terminates in a fine point behind; it bears 74 rows of teeth, but there are no central teeth or spines. The ground colour of the preserved specimen is a dull greenish brown; on the dorsum there are numerous, more or less close-set, rounded, purplish black spots; the margin of the mantle is almost whitish and the branchiae spotted with white. A coloured sketch of the animal in life shows much the same colouration, but the branchiae and rhinophores are dark brown or almost chestnut, and there is a row of red dots along the margin of the mantle and a few red spots on the tail. This species is one of the most prettily and brightly coloured of Krusadai Nudibranchs. Pamban bridge.

Sub-family ARCHIDORDIDINAE.

A single species belonging to the genus *Trippa* has been recorded from Pamban.

Genus **Trippa** Bergh, 1877.

The body is soft and the dorsum bears tufts of wart-like tubercles; the tentacles are small; the anterior margin of the foot is united with the head by a fold of the integument. The hind part of the buccal tube bears ptyaline as well as salivary glands. A prostate is absent.

Trippa tristis (Alder & Hancock).

Plate XXXII, fig. 1.

Doris tristis, Alder & Hancock, Trans. Zool. Soc. London, V, 1866, p. 121, pl. xxx, figs. 6 and 7.
Doris tristis, Eliot, Proc. Zool. Soc. London, 1903, II, p. 361.
Trippa tristis, Eliot, Proc. Zool. Soc. London, 1906, II, p. 1006.
Trippa tristis, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p. 154.

This species is represented in the collection by a single specimen collected at Pamban. It is referred to as *Doris tristis* by Alder and Hancock, but Eliot has indicated its correct position in the genus *Trippa*. The animal is small and measures only 9 mm. long, 5 mm. wide and 3 mm. high. The body is elongately ovoid, with a slightly raised dorsum. The mantle is moderately soft and its surface is raised into angular ridges and swellings; a particularly prominent ridge runs longitudinally along the middle of the back; there are also irregular ridge-like elevations at the sides of the back. The surface of these ridges bears minute tubercles, while the hollow interspaces between them are reticulated with fine whitish lines, the meshes of the network being blackish. The dorsal tentacles have retracted deeply into their sheaths in the present specimen; these sheaths are prominent, rounded structures, strongly tuberculated outside and serrated at the edge. The oral tentacles are distinctly seen as small, finger-shaped structures. There are four secondary branchiae, broad, tripinnately branched and of a paler colour than the mantle; the margin of the branchial orifice is thickened, raised and produced into a large vertical process anteriorly. The foot is large and deeply notched at the anterior margin. The preserved specimen is of a dull greenish brown colour, marked with small irregular dark brown markings on the sides and margins of the dorsal surface and minutely reticulated with white lines on the lower surface of the mantle. The radula is short and bears 18 rows of teeth, but there is no rachidial tooth. Pamban.

Sub-family DISCODORIDINAE.

A single genus, *Thordisa*, is represented at Pamban.

Genus Thordisa Bergh, 1877.

The dorsal surface of the mantle bears soft, elongated processes of moderate length. A labial armature is generally absent (but present in *T. crosslandi*). The tentacles are very short. The foot is moderately large, usually laminated or notched at the anterior margin. (See Eliot, *Proc. Zool. Soc. London*, II, 1906, p. 654).

Two species, *T. villosa* and *T. crosslandi*, are represented in the Krusadai collection. The latter may at once be distinguished from the former by its relatively enormous size, much deeper and brighter colouration, the dorsal tentacles being more strongly developed and elongately conical, and by the presence of a labial armature.

Thordisa villosa (Alder & Hancock).

Plate XXIX, figs. 3*a* to 3*c*.

Doris villosa, Alder & Hancock, Trans. Zool. Soc. London, V, 1866, p. 119, pl. xxxiii, fig. 1.
Thordisa villosa, Eliot, Proc. Zool. Soc. London, 1903, II, pp. 367 and 368, pl. xxxii, figs. 1 and 2; pl. xxxiii, figs. 1—3.
Compare *Thordisa maculigera*, Bergh, in Semper's Reisen Heft., XII, 1877, p. 540.
Thordisa maculigera, Bergh. Danish Expedition to Siam, Opisthobranchiata, 1902, p. 182.
Thordisa villosa, Eliot, Proc. Zool. Soc. London, 1906, II, pp. 655—666 and p. 1006.

There is a single specimen of this species from Shingle Island in the Museum collection, preserved in fairly good condition, but the colour has almost completely disappeared. The body is broadly ovoid with a convexly raised dorsum. The mantle is large, slightly indented anteriorly, and covered all over with numerous, very small, close-set, papilla-like tubercles; the larger of these often bear delicate filaments at their tips. The dorsal tentacles, though contracted and somewhat retracted into their sheaths in the present specimen, can be made out as small, conical, finely grooved structures pointing backwards. The oral tentacles are elongate. Along the centre of the back, there are one or two ill defined, wart-like protuberences. The secondary branchiae are six in number, beautifully plume-shaped and tripinnately branched; they are brownish and form an incomplete circle. The margin of the branchial orifice is raised into a well defined wall surrounding the bases of the branchiae. The foot is large, with a broad, flattened sole, and is strongly laminated in front. The preserved specimen is uniformly pale yellow on the dorsal surface and a shade darker on the lower, but in life the animal is transparent yellow with a reddish brown blotch at the centre of the dorsal surface and numerous large spots and markings of the same colour round the broad mantle margin; the ventral surface is uniformly bright yellow with brown dots. The radula consists of 60 rows of teeth which are hamate, (*i.e.*, hook-shaped) and mostly smooth but the outermost ones bear hair-like denticles. Eliot regards this species to be identical with *Thordisa maculigera*. The present specimen measures 15 mm. long, 9 mm. wide and 6 mm. high. **Shingle Island.**

Thordisa crosslandi Eliot.

Plates XXX and XXXI.

Thordisa crosslandi, Eliot, Proc. Zool. Soc. London, 1903, II, pp. 368 and 369; pl. xxxii, fig. 3; pl. xxxiii, figs. 4—8.
Diaulula (?) *gigantea*, Bergh, Siboga-Expeditie, Opisthobranchiata, Monogr. XXV, 1905, p. 119; pl. xv, figs. 11—16.
Thordisa crosslandi, Eliot, Proc. Zool. Soc. London, 1906, II, p. 656.
Argus indicus O'Donoghue, Proc. Malac. Soc, XX, pt iii, 1932, p. 156 (misidentified).

This species is represented in the collection by a single large specimen collected at Kundugal Point, measuring 140 mm. long, 80 mm. wide and 25 mm. high in the preserved state. The history of the naming of this specimen is interesting. It was originally wrongly identified as *Discodoris fragilis* and recorded as such in the previous list of Krusadai Mollusca [*Bull. Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 102]. Later it was sent to Dr. O'Donoghue along with other Pamban Nudibranchs and was described by him as a new species, *Argus indicus* in the paper cited above; finally Col. H. C. Winckworth re-examined the same specimen, and referred it with certainty to *Thordisa crosslandi*, under which name therefore it is recorded in the present paper. Eliot considers that this species is identical with *Diaulula gigantea* of Bergh.

The body is more or less dorso-ventrally flattened, and the mantle large and outspreading. The integument is tough and leathery, but contains no spicules. The entire dorsal surface is covered with small, close-set, rounded papillae, with somewhat pointed tips; but in life these papillae are said to be more elongate and sometimes even bear filaments at their tips; smaller and larger papillae are inter-mixed indiscriminately, but as a rule those near the centre are smaller than those on the marginal areas. The head is well developed, rounded and lies between the mantle and the foot. The mouth is a transverse slit at the front end of the head. The head bears on each side a small cylindrical oral tentacle, which are whitish with yellowish tips. The foot is large, broadly ovate, with a flattened sole; anteriorly it is cleft into a dorsal and ventral lip, the cleft passing backwards for a short distance behind along the lateral margins of the foot; the upper lip of the foot so formed is deeply notched along the middle line. The rhinophores are completely withdrawn into their sheaths in the present specimen; the apertures of the rhinophoral sheaths are distinctly raised and bear a tuberculated edge. The branchiae are six in number, tripinnately branched and are arranged in an incomplete circle, open behind. At the centre of the circlet of branchiae lies the anus on a papilla bearing nine granules at its tip. The preseved specimen still retains a considerable part of its original colour markings; it is of a dirty greyish brown colour, mottled with large, dark grey and blackish patches. The lower surface of the mantle is bluish grey with irregular, brownish black patches which tend to coalesce freely. The sole of the foot is also of the same colour and marked with scattered, circular, brownish black spots. The buccal mass is large and the lips are lined with chitin. The radula is strongly

developed and bears 48 rows of teeth. The animal is said to be sedentary in its habits, but is occasionally able to swim well. It has also the power of throwing off portions of the mantle as a means of self-protection. Kundugal Point.

Sub-family ASTERONOTINAE.

Two genera, *Halgerda* and *Asteronotus* are represented at Pamban, each by a single species. In the former, the dorsum is covered with a network of ridges radiating from raised centres and the branchiae are tripinnately branched; while in the latter the dorsum is tough and leathery, usually smooth and even slimy, and angular along the middle, and the branchiae are generally quadripinnately branched.

Genus **Halgerda** Bergh, 1880.

The body is moderately elongated with a fairly rough dorsum which bears a network of raised ridges. The tentacles are small. The branchiae are small, tripinnately branched plumes. The lips are unarmed.

A single species has been recorded from Pamban.

Halgerda apiculata (Alder & Hancock).

Plate XXXII, fig. 2.

Doris apiculata, Alder & Hancock, Trans. Zool. Soc. London, V, 1866, p. 122, pl. xxx, fig. 8.
Halgerda punctata, Farran, in Herdman, Ceylon Pearl Oyster Fisheries Suppl. Report, Opisthobranchiata, III, 1905, p. 339.
Halgerda apiculata, Eliot, Proc. Zool. Soc. London, 1906, II, pp. 645 and 1002.
Halgerda apiculata, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p 155.

This species, originally referred to by Alder and Hancock as *Doris apiculata*, and later correctly assigned by Eliot to the genus *Halgerda*, is represented in the collection by a single specimen collected at Pamban. It measures 7 mm. long, 3·5 mm. wide and 2 mm. high. The body is convex and oblong-ovate in outline. The mantle is tough and is raised into a network of ridges which are frequently seen radiating from raised, nodule-like, conical papillae, which are continued upwards as short, spine-like projections; these projections have been, however, rubbed away from the central area of the dorsum in the present specimen. On very close examination, the surface of these nodules and ridges is found to be minutely papillate throughout. The mantle and the foot bear rod-like spicules. The foot is narrow, well developed and clearly separated from the body; its anterior margin is notched along the middle line, and its lower surface smooth and evenly flattened. The rhinophores have completely retracted within their sheaths; the latter, however, are seen as small, rounded pits whose margins are raised into fine, spiculate points. The branchial plumes are also badly shrunk; they are five in number and tripinnately branched; the margin of the branchial orifice is finely crenulated. The colour of the preserved specimen is a more or less uniform

dirty greyish, but the meshes of the network on the dorsal surface are much darker than the relatively pale, almost yellowish ridges and nodules. A narrow marginal strip of the dorsal surface all round is devoid of nodules and is pale brownish yellow. The lower surface of the mantle is finely reticulated with whitish lines which give it, as Alder and Hancock have aptly pointed out, a sponge-like appearance. The radula is very much as in *Trippa tristis*, and all the teeth are smooth and hook-shaped. Dr. O'Donoghue suggests that the form referred to as *Halgerda punctata* by Farran may also belong to the present species, the minor differences being due to shrinkage and state of preservation. Pamban.

Genus **Asteronotus** Ehrenberg, 1831.

The dorsum is leathery, smooth or warty, and angular along the middle ; the branchial orifice is star-shaped. The lips are devoid of an armature.

Asteronotus madrasensis O'Donoghue.

Plate XXXII, figs 3*a* to 3*d*.

Asteronotus madrasensis, O'Donoghue, Proc. Malac Soc , XX, pt. iii, 1932, p 158.

The type specimen of this species was collected on Krusadai Island by Dr. B. Sundara Raj of the Madras Fisheries. The preserved animal measures 76 mm. long, 41 mm. wide and 39 mm. high. The body is rather contracted and appears plump and almost rectangular in cross section. The mantle is rounded in front and behind and is thrown into a series of wide transverse folds. Behind the rhinophoral sheath on each side is a small group of flattened papillae. The head is sub-spherical, and placed in the groove between the mantle and the foot ; it bears a small, cylindrical oral tentacle on each side. The foot is oval, broadly rounded in front and more narrowly behind. The margin of the foot is much wrinkled and folded. Its front margin is divided into a dorsal and ventral lip by a transverse cleft much as in *Thordisa crosslandi*, and the upper lip, again, is deeply notched in front (as in that species) along the middle line. The rhinophores have a short, cylindrical stalk and are deeply retractile into deep sheaths with rounded margins The branchiae are six in number, quadripinnately branched and are arranged in a circle. They are retractile into a deep sheath with a smooth margin. The anus lies in the centre of the circlet of branchiae on a well marked papilla. The reproductive aperture lies well in front on the right side of the body, slightly behind the level of the rhinophores The general colour of the preserved specimen is a pale dirty grey ; but a note accompanying the specimen states that the colour in life was brown with black spots, but on the dorsum all trace of colour has disappeared , however, the papillae on the right side are partly black and the branchiae brown ; the dorsal surface of the foot flange and the ventral surface of the foot have black spots and blotches. The buccal mass is large and is divided into an anterior chamber and a posterior muscular portion containing the radula ; the inside of the anterior chamber is papillated. The radula

is large and well developed and contains 46 rows of teeth. Dr. O'Donoghue states that the compact, plump appearance of the specimen is probably due to considerable shrinkage during preservation. Krusadai Island.

Family DENDRODORIDIDAE (=DORIDOPSIDAE).

The body is more or less soft, with a large mantle which may either be smooth or warty. The dorsal tentacles are small and retractile within sheaths. Oral tentacles are absent. The mouth is suctorial, opening on the front margin of the foot, without jaws, radula or collar, but with a retractile proboscis in front.

This family includes a single genus, *Dendrodoris.*

Genus **Dendrodoris** Ehrenberg, 1831.

(Syns. **Doriopsis** Bergh, 1875, non Pease, *1860.*
Doridopsis Alder & Hancock, 1864).

The body is more or less depressed, and the mantle which covers the head and the foot is either smooth or bears soft tubercles. The dorsal tentacles are laminated ; the secondary branchiae are plume-shaped and retractile into a common sheath-like cavity.

This genus is divided into two sub-genera, *Dendrodoris s. str.* and *Doriospsilla,* both of which are represented at Krusadai. The latter is distinguished from the former by the firmer and more rigid consistency of the body, and by the dorsal surface of the mantle being distinctly granular.

Sub-genus **Dendrodoris** s. str.

The body is soft and the upper surface is smooth. The buccal ganglion is situated in the hind part of the pharynx.

Two species, *D. rubra* and *D. nigra,* have been recorded from the Pamban area. The latter may be readily distinguished from the former, which is much commoner, by the intense bluish black colour of the mantle and the smoky grey colour of the foot ; *D. rubra,* on the other hand is bright reddish. Further, there are eight branchiae in *D. nigra,* while in *D. rubra* there are only six.

Dendrodoris rubra (Kelaart).

Plate XXXII, figs. 4*a* and 4*b*.

Doris rubra, Kelaart, Journ. Roy Asiat. Soc (Cey Br), III, 1858, p. 101.
Doris rubra, Kelaart, Ann. Mag Nat. Hist. ser. 3, III, 1859, p. 298.
Doridopsis rubra, Alder & Hancock, Trans. Zool. Soc. London, V, 1866, p. 126, pl. xxxi, figs. 1 and 2.
Dendrodoris rubra, Eliot, Spolia Zeylanica, VI, pt. 23, 1909, p. 95.
Dendrodoris rubra, O'Donoghue, Proc. Malac. Soc , XX, pt. iii, 1932, p.163.

This is one of the commonest species of Nudibranchs occurring at Krusadai, and several good specimens are preserved in the collection. They range from 0·2″ to 1·4″ in length, but living specimens, fully extended, may measure as much as 3″ in length. The animals are generally seen as soft, plump, cherry-red objects sticking to the under surface of stones on the reefs, and are particularly common on the reefs adjoining Shingle Island. The body is soft and fleshy, broadly ovate in outline and somewhat depressed. The mantle is large, well developed, over-spreading and entirely covers the head and the foot ; its margin stands out as a broad, thin, outstanding flange all round ; this flange is deeply folded in most of the preserved specimens. The surface of the mantle is smooth and soft. The dorsal tentacles are placed close to each other very near the front margin ; in most specimens they are badly contracted, but in a few they are seen well extended. They are beautifully laminated the laminae being divided for the most part by a median longitudinal ridge. The head is not distinctly marked off from the rest of the body, and bears lateral lobes. There are six well developed secondary branchiae, each of which is divided into four pinnate branches. The foot is broad, with a smooth and flattened sole, but in some preserved specimens its ventral surface is intensely wrinkled due to shrinkage. The mouth is a small circular aperture opening at the somewhat angular front margin of the foot ; it is suctorial and the buccal mass is devoid of radula and jaws. The rhinophores and branchiae are retractile within their sheaths. Many of the preserved specimens are of a more or less uniformly dark ashy brown colour and a few have turned almost completely whitish, but faint traces of the original reddish colour may still be made out on the mantle of some of them. In life, the animal is of a bright rosy red colour, with brownish or dark red blotches ; the thin marginal flange of the mantle is definitely much paler than the central parts ; the centre of the sole of the foot is of a much darker red colour than the peripheral portion ; the tentacles are also rose-red, with darker red tips. Two specimens in the collection are of markedly darker colouration than the rest and probably belong to the variety referred to by Alder and Hancock (*Trans. Zool. Soc. London,* V, 1866, p. 126.). Pamban, Krusadai and Shingle Islands.

Dendrodoris nigra (Stimpson).

Plate XXXII, fig. 5.

Doris nigra, Stimpson, Proc. Philadel Acad. Nat. Sci., VII, 1855, p. 380
Doris atrata, Kelaart, Journ. Roy Asiat. Soc. (Cey. Br), III, 1858, p. 103
Doris atroviridis, Kelaart, Ann. Mag Nat. Hist , ser. 3, III, 1859, pp. 299 and 300.
Doridopsis nigra, Alder & Hancock, Trans. Zool. Soc. London, V, 1866, p 128, pl. xxxi, figs. 13—16.
Doridopsis nigra, Eliot, Proc Zool. Soc London, 1906, II, p 664.
Dendrodoris nigra, Eliot, Spolia Zeylanica, VI, pt. 23, 1909, p. 94.
Dendrodoris nigra, O'Donoghue, Proc Malac. Soc , XX, pt. iii, 1932, p 163.

This species is reported to be widely distributed, being well represented in the Indian seas, and has also been recorded from the Maldives, but only a single specimen collected

from the Pamban area is represented in the collection. The preserved specimen measures 20 mm. long, 11 mm. wide and 7 mm. high. The body is slightly narrower, more elongate and with a more convexly raised dorsum than in the preceding species. The head is slightly more distinctly marked than in *D. rubra* and is indicated by a slight arched swelling in front of the foot, and somewhat angular at the sides. The foot is well developed, elongate and provided with a median longitudinal depression at the anterior margin in which is lodged the small circular mouth. The dorsal tentacles are beautifully laminated and have their upper portions bent backwards ; the laminae are broad, about 18 in number and divided in front by a ridge. The mantle is large, over-spreading and fairly firm and smooth as in *D. rubra*. There are eight blackish secondary branchiae, compactly set in an incomplete circle very near the posterior margin ; they are tripinnately branched and finely plume-shaped. This species is subject to a certain amount of colour variation. The present specimen belongs to the form *D. nigra var. nigerrima* of Bergh ; it is of an intensely dark, bluish black colour all over with the exception of the tips of the dorsal tentacles which are conspicuously pure white ; but the margin of the mantle is slightly paler, especially anteriorly and the sole of the foot is of a dull ashy or smoky black colour. Shingle Island.

Sub-genus **Doriopsilla** Bergh, 1880.

The body is tough, often warty or granular above The buccal ganglion is situated in the anterior part of the pharynx.

Doriopsilla sp.

There is a single unidentified specimen in the collection, from Krusadai Island, labelled "*Doriopsilla sp.*" It is moderately large, with a broadly ovate outline and somewhat depressly convex dorsum, measuring 20 mm. long, 14 mm. wide and 8 mm. high. The mantle and the foot are firm and tough. The dorsal tentacles are placed far forwards, almost at the anterior extremity of the dorsal surface ; they are closely laminated, the laminae being partly divided by a median ridge. There are eight branchial plumes, tripinnately branched and forming a complete circle. The foot is well developed, elongated and carries the small mouth on its front margin. The upper surface of the mantle is closely and finely granulated, the granules being smaller and inconspicuous towards the periphery. The preserved specimen is uniformly greyish, the original colour having probably disappeared altogether. The specimen approximates in many respects *Doriopsilla miniata*, Alder and Hancock (*Trans. Zool. Soc. London*, V, 1866, p. 130), but differs from it in the number of the branchial plumes and in the normal position of the anus.

Family ARMINIDAE.

The dorsum is more or less broad and flattened ; the anterior part of the head bears short lateral lobes ; the anus is situated on the right side ; the jaw plates are devoid of

masticatory processes. The penis is unarmed. The animals usually burrow in sand or mud and thus ordinarily escape the notice of the collector.

One genus, *Pleurophyllidiella,* is represented at Pamban. The record of the species referred to as *Pleurophyllidia gracilis* Bergh, in the previous list of Krusadai Mollusca [*Bull. Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 103], is unfortunately based on wrong identification as the same specimens have been later determined by Dr. O'Donoghue as belonging to a new species of a different genus, *Pleurophyllidiella.*

Genus **Pleurophyllidiella** Eliot, 1903.

The body is without dorsal papillae and without the paired anterior branchiae, though there are always nearly 30 lateral lamellae on the lower surface of the margin of the mantle; they extend from the head to the tail and are irregular in size and shape. The mouth is ventral and forms a large, transverse slit which tends to be T-shaped.

Pleurophyllidiella paucidentata O'Donoghue.

Plate XXXII, figs. 6*a* to 6*g*.

Pleurophyllidiella paucidentata, O'Donoghue, Proc Malac Soc., XX, pt. iii, 1932, p 149.

There are eight specimens of this species in the collection, collected at Pamban and Pamban bridge on three occasions. The largest specimen measures 11 mm. long, 4·5 mm. wide and 3·25 mm. high; the others very nearly approach this size. The body is somewhat depressed, flattened, elongate, obtusely rounded in front and bluntly pointed behind. The dorsum bears a series of 10-12 well developed, raised, longitudinal and more or less parallel ridges of which the middle three extend right up to the posterior end; in many specimens, adjacent ridges sometimes unite or some of the ridges bifurcate; the interstices between the main ridges bear much finer and lower longitudinal ridges. The mantle margin extends as a well marked flange all round, this flange bears a notch in the middle anteriorly. The sides of the body are almost vertical, so that the body is more or less squarish in cross-section. The head is well developed and produced dorsally into a well marked cephalic shield. In the specimens examined this shield is so strongly contracted as to almost appear bilabiate in a view from below. The dorsal lip is much larger than the ventral, and the mouth appears as a small aperture just in front of the middle of the lower lip. The foot is well developed, narrow, elongated, flattened below, bluntly rounded and thickened at the anterior margin and passes behind into a narrow, pointed tail; the margin of the foot is marked by a distinct flange. The rhinophores are longitudinally grooved and are placed close together on the dorsal surface of the head immediately beneath the anterior notch. Dorsal branchiae are absent, but the lateral lamellae characteristic of the genus are reduced in the present species to two small longitudinal folds on the lower surface of the mantle where it joins the body

wall at the anterior end ; they may be easily overlooked when the mantle is expanded. In the preserved animal the dorsum is dark grey, or almost blackish, with the ridges definitely paler and of a greyish white colour, but the dark colour varies in intensity and is generally disposed in three or four broad, transverse bands ; the rest of the body is uniformly dirty pale yellow. A coloured sketch of this species shows the dorsal ridges to be pale yellowish white, with the darker parts ranging from dark grey to black. The buccal funnel is provided with a chitinous lining which bears masticatory edges. The radula consists of 32 or 33 rows of teeth, and has fewer teeth in each row than is usual in the family— a fact indicated by the specific name of the species. Pamban and Pamban bridge.

Family BORNELLIDAE.

The body is more or less elongated and laterally compressed ; the anterior margin always bears a conical or cylindrical process on a short stalk ; the rhinophores are large and long-stalked, with the distal portion strongly laminated ; each of the lateral margins of the dorsal surface bears a series of large branched branchial processes. The anus is situated on the right side.

A single species, belonging to the genus *Bornella*, is recorded from Pamban.

Genus **Bornella** (Gray) Adams & Reeve, 1848.

The body is moderately slender ; the margin of the rhinophore sheath bears finger-shaped processes.

Bornella digitata Adams & Reeve.

Plate XXXIII, fig. 1.

Bornella digitata, Adams & Reeve, Zoology of the " Samarang," 1850, Mollusca, p. 67.
Bornella hancockana, Kelaart, Journ Roy. Asiat. Soc. (Cey. Br), III, 1858, p. 269.
Bornella digitata, Alder & Hancock, Trans. Zool Soc. London, V, 1866, p. 140, pl. xxxiii, figs. 8 and 9.
Bornella digitata, Eliot, Journ. Conchol., XI, 1905, p. 238
Bornella digitata, Eliot, Proc. Zool. Soc. London, 1906, II, p. 674
Bornella digitata, Eliot, " The Nudibranchs of Okhamandel", Rep. to Govt. of Baroda on Marine Zoology, 1909, p. 140.
Bornella digitata, O'Donoghue, Proc Malac. Soc , XX, pt. iii, 1932, p. 148.

This species is represented in the collection by two specimens from Shingle Island, and one from Krusadai Island. The largest specimen measures 25 mm. long, 4 mm. wide and 4 mm. high, but the other two are somewhat smaller. The body is rather slender, narrow, greatly elongated and strongly laterally compressed. Of the three preserved specimens one is nearly black, while the other two are more or less uniformly pale yellowish grey ; but in life, the animal is flesh-coloured, traversed all over by crimson, reticulated lines. Adams and Reeve's coloured sketch of the animal gives a good idea of the colouration of this species. The sides of the head are produced in front into two, rounded, star-like lobes, with

about six, short, radiating finger-like processes, on the margin. The dorsal tentacles are large, club-shaped, obliquely laminated and are surrounded by long, tubular, cylindrical sheaths, the upper margin of which bears four elongated processes, one of which is much larger than the rest ; these filaments are banded with bright red and tipped with yellow during life ; the tentacles are completely retractile into these sheaths. There is a longitudinal row of six large branchial processes on each side of the dorsum, diminishing in size posteriorly. They are borne on short peduncles and branch above at the free margin into two or three stout processes, each of which is banded with crimson, yellowish above and tipped with white during life ; at the inner base of these papillae arise three delicate pinnately branched plumes which are whitish or pale yellow. The body narrows considerably posteriorly and terminates in a pointed tail behind. The foot is narrow and elongated, and, in the preserved specimens, it is reduced to a mere longitudinal ridge on the ventral surface, by contraction ; but in life, its sides spread out slightly as a distinct flange. The surface of the integument is covered all over with low tubercles of irregular size. The animals are said to swim rapidly by lateral flexions of the body when detached from their substratum. The radula bears from 8—19 lateral plates. Krusadai and Shingle Islands.

Family HANCOCKIIDAE.

The body is small, slender, with a more or less broadened head. The rhinophores are surrounded by stalk-like sheaths the margin of which is expanded ; the dorsal processes are more or less large, usually tuberculated. The foot is narrow and rounded in front. The anus is placed on the right side of the dorsal surface.

The specimen referred to as *Doto indica*, Bergh, in the previous list of Krusadai Mollusca [*Bull. Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 103] was later re-examined by Dr. O'Donoghue, who described it as a new species, belonging to a new genus, *Iduliana*, which he created for the reception of this species, but which has been subsequently shown to be a synonym for *Hancockia* Gosse, 1877.

Genus **Hancockia** Gosse, 1877.

(Syn. **Iduliana** O'Donoghue, 1932).

The oral veil possesses a group of papillae on each side. There is a median anterior dorsal swelling, and a series of tube-like ridges connecting it with the cerata. A series of papillae, with simple or branched extremities lie along the mid-dorsal line. The rim of the rhinophore sheath is furnished with papillae, but the rhinophores are quite smooth.

Hancockia papillata (O'Donoghue).

Plate XXXIII, figs. 2*a* and 2*b*.

Iduliana papillata, O'Donoghue, Proc. Malac. Soc , XX, pt. iii, 1932, p. 146.
Hancockia papillata, Odhner, Mem. Mus. Nat. Hist , Belgium, (2) III, 1936, p 1105.

The type specimen of this species, which was obtained for examination from the Indian Museum, was collected on Krusadai Island, and is very small, measuring only 4 mm. long, 1·25 mm. wide and 2 mm. high, excluding the cerata. The body is limaciform, with a convex dorsum which merges into the vertical sides without any well marked line of demarcation. On each side of the dorsal surface there is a row of seven cerata ; they are club-shaped and bear 8—9 tubercles each, on the lateral surface. Along the middle of the dorsal surface there is a broad, hemispherical swelling from which there passes out a tube-like ridge behind and a pair of similar ridges in front ; the posterior ridge is particularly conspicuous In front of the elevation in the mid-dorsal line there is a pair of small, pointed papillae, and a row of 10—12 papillae spring from the median elevation ; the tips of these latter are branched into three or four processes. The head is retracted and is overhung by the cephalic veil which bears on each side a group of six small, digitiform papillae. The foot is well developed, narrow and marked off from the sides of the body by a well marked flange ; it is bluntly rounded in front, with a median notch, while posteriorly, it terminates in a pointed tail ; the lateral margins of the foot are thrown into strong folds in the preserved specimen. The rhinophores are much contracted and appear as short, smooth, conical papillae ; the rhinophore sheath is cylindrical and slightly expanded at the top, where it bears a circlet of 11 digitiform papillae. The preserved specimen is of a pale greenish grey colour throughout, with no sign of any definite colour markings or pattern. The lips are covered with a chitinous layer, but true jaws are absent. The radula is triseriate and bears 51 rows of teeth. Krusadai Island.

Family FLABELLINIDAE.

The body bears more or less numerous unbranched papillae all over the dorsal surface. The dorsal ramified branchial appendages are club-shaped and distinctly separated. Both oral tentacles and rhinophores are greatly elongated and the latter generally bear ring-shaped lamellae. The anus is situated on the right side.

The species referred to as *Galvina producta* in the previous list [*Bull. Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 102] properly belongs to this family, but Dr. O'Donoghue has adopted the generic name *Eubranchus* Forbes, 1838, as it has priority over *Galvina* Alder and Hancock, 1855.

Genus **Eubranchus** Forbes, 1838.

(Syn. **Galvina** Alder & Hancock, 1855).

The dorsal processes are club-shaped and thickened. Salivary glands are present in the buccal tube.

Eubranchus productus (Farran).

Plate XXXIII, figs. 3*a* to 3*e*.

Galvina producta, Farran, in Herdman, Ceylon Pearl Oyster Fisheries Suppl. Report, Opisthobranchiata, III, 1905, p 331 ; pl i, figs. 6—9.
Eubranchus productus, O'Donoghue, Proc. Malac. Soc , XX, pt iii, 1932, p. 145.

A single specimen, collected on Krusadai Island, has been, with a slight degree of uncertainty, referred to this species. The type specimen of this species recorded by Farran from Ceylon is reported to have measured 9·5 mm. in length, but the present specimen measures only 4·5 mm. long, 0·75 mm. wide and 0·75 mm. high, so that it is considerably smaller. The animal is slender, narrow and elongated. The dorsal papillae are inflated, tapering above and constricted just below their tips which are somewhat opaque. The rhinophores are moderately long but the oral tentacles are short. In external form and structure the present specimen agrees fairly well with Farran's description, except in one respect : Farran's specimen had the antero-lateral corners of the foot produced into well marked, tentacle-like processes which, as he has pointed out, is unlike other members of the genus. The present specimen, on the other hand, has the corresponding corners thickened and knob-like, though it is possible that they were extensile when the animal was alive. The preserved specimen is of a uniform pale yellowish brown colour. On account of the minute size of the specimen, and the necessity to retain it as intact as possible it had not been possible to examine the radula satisfactorily. There are about 9 very tiny rachidial teeth. Dr. O'Donoghue admits that further material is necessary for an absolutely conclusive identification, but for the present he deems it safe to refer it to the present species. Krusadai Island.

Family TERGIPEDIDAE.

The body is somewhat laterally compressed ; the rhinophores are simple and smooth. The dorsal processes are cylindrical, sometimes club-shaped, and are arranged in two or more rows. The margins of the jaws are toothed ; the foot is usually rounded The anus is situated laterally.

A single genus, *Hervia*, is recorded from Pamban.

Genus **Hervia** Bergh, 1871.

The body is slender with the foot somewhat narrower than the dorsum and with the anterior angles well produced. The oral tentacles are long, while the rhinophores are somewhat shorter and thicker. The dorsal processes are spindle-shaped and disposed in groups.

Two species, *H. militaris* and *H. ceylonica*, are represented in the collection. In the latter, which is much smaller than the former (being only about half its length), the rhinophores are short and more or less uniformly slender, the anterior angles of the foot are only moderately produced and the dorsal papillae are arranged in 5—6 transverse rows, while in the

former, the rhinophores are rather long and swollen in the middle, the anterior angles of the foot more strongly produced and the dorsal papillae are arranged in about six clusters on each side ; further, in *H. ceylonica,* there are only five lateral denticulations on either side in the radula, while in *H. militaris* there are seven lateral denticulations.

Hervia militaris (Alder & Hancock).

Plate XXXIII, figs. 4*a* to 4*c*.

Eolis militaris, Alder & Hancock, Trans. Zool. Soc London, V, 1866, p. 144, pl. xxxiii, fig. 15.
Hervia militaris, Eliot, Proc. Zool. Soc. London, 1906, II, pp. 1000 and 1007.
Hervia militaris, Farran, in Herdman, Ceylon Peral Oyster Fisheries Suppl. Report, Opisthobranchiata, III, 1905, p. 331.
Hervia militaris, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p. 143.

The specimens referred to as *Phidiana unilineata* (which resembles he present species closely) in the previous list [*Bull. Mad. Govt. Mus.* (*Nat. Hist.*), I, No. 1, 1927, p. 102], were later correctly identified as *Hervia militaris.* There are three specimens of this species in the collection, two from Shingle Island and one from Pamban, the last being slightly damaged. The largest specimen measures 15 mm. long, 4 mm. wide and 4 mm. high behind the first group of cerata. The body is rather short, laterally compressed and tapering to a fine point behind. The head is moderately broad, and the oral tentacles are stout, elongated and tapering at the extremities. The rhinophores are rather long, swollen at the middle and narrowing to a pointed tip above. There are numerous dorsal branchial papillae which are cylindrical and finger-shaped with pointed tips, and grouped in six clusters arranged in a row on either side, but they almost meet at the middle of the back. The foot is narrow, elongated, and in the present specimens much contracted, resembling a deeply grooved, ridge-like thickening on the ventral surface ; its antero-lateral corners are strongly produced into stout processes, while posteriorly it terminates in a pointed tail. The colour of the preserved specimens is a dull dark grey, and the cerata are of a distinctly darker brownish grey, with whitish tips, but all traces of the original colour markings have disappeared. The colour notes accompanying the specimens state that the animal in life was " white with red lateral lines and dark bluish cerata with a touch of red preceding the white tips," but in Alder and Hancock's specimen they are said to be reddish brown with bright yellow tips. The lips are lined internally with chitin and the jaws are a pair of thin, oval, smooth, shell-shaped structures. The radula is uniseriate and, in the present specimens, contains 23 teeth. Pamban and Shingle Island.

Hervia ceylonica Farran.

Plate XXXIV, figs. 1*a* to 1*e*.

Hervia ceylonica, Farran, in Herdman, Ceylon Pearl Oyster Fisheries Suppl. Report, Opisthobranchiata, III, 1905, p. 331, pl. i, figs. 1—5.
Hervia ceylonica, O'Donoghue, Proc. Malac. Soc., XX, pt. iii, 1932, p. 143.

A single small specimen of this species, collected on Krusadai Island is represented in the collection. This species has been previously recorded from the Gulf of Manaar by Farran who described it as new. The present specimen measures 7 mm. long, 1 mm. wide and 1 mm. high, and is in a rather poor state of preservation, with many of the cerata fallen away. The body is elongated, narrow and bears about five, irregular, transverse rows of cerata on the dorsal surface ; they are proportionately longer, but less numerous than in the preceding species ; they are slender and elongated with pointed tips, and the dirty brownish hepatic contents are distinctly seen through their thin walls. The oral tentacles are long, very stout at the base, but finely pointed at the tip The rhinophores are moderately short, slender and smooth. The foot is narrow, elongated and pointed behind, with a narrow, flattened sole, and with the antero-lateral corners moderately produced. The preserved specimen is of a uniformly dirty greenish grey colour, but its exact colouration during life has not been noted yet, as Farran's specimens are said to have been faded The jaws bear short, denticulated cutting edges. The radula is uniseriate and contains 19—20 teeth, but as the jaws and teeth do not agree with Farran's account, Dr. O'Donoghue admits that further material is needed to confirm the present identification. Krusadai Island.

Sub-Class PULMONATA.

Of the few Pulmonata (or lung-breathing Mollusca) that have reverted to a more or less marine habitat, three families are represented :—

1. Onchidiidae, without a shell.
2. Siphonariidae, with a patelliform shell, and
3. Pleurodontidae, with a spiral or snail-like shell.

Order Basommatophora.

SERIES PATELLIFORMIA.

Family SIPHONARIIDAE.

The shell is bowl-shaped or cap-shaped, somewhat resembling a limpet, usually radiately ribbed, and brightly coloured. There is a shallow, radial groove on the right side of the inner surface, rendering them more or less distinctly asymmetrical, and distinguishing them from the true limpets. The foot is large and rounded and the head broad and without tentacles.

This family includes a single genus, *Siphonaria*, comprising the lung-limpets.

Genus **Siphonaria** G. B. Sowerby, 1824.

With the characters of the family.

A single species is represented at Pamban.

Siphonaria stellata (Helbling).

Plate XXXIV, figs. 2*a* and 2*b*.

Patella stellata, Helbling, Abhandl. Privatges. Bohm. IV, 1779, p. 109, pl. i, fig. 11.
Siphonaria exigua, Sowerby, Genera of Shells, 1824, pl. 143—144.
Siphonaria luzonica, Reeve, Conch. Icon., ix, 1856, *Siphonaria*, pl. vi, fig. 29.

Six dead shells of this species are contained in the collection The shell is small (the largest in the collection measuring only 7 mm. long, 5 mm. wide and 4 mm. high); it is limpet-shaped, with a broadly ovate profile and a pointed apex which is placed slightly behind the middle; it is small, beak-shaped and definitely but slightly bent backwards. The outer surface is rather rough and bears strong, raised ribs radiating from the apex; some of the interstices between the main ribs are traversed by thinner secondary ribs which terminate before reaching the apex. Concentric lines of growth are also distinctly seen on the surface. The inner surface is smooth and bears as usual a broad, shallow groove on the right side, the position of which is marked by a corresponding elevation on the outer surface. The presence of the groove renders the right margin of the shell more or less angular where it meets the edge. The shells in the collection are somewhat faded; they are whitish, but a few of them show distinct, brownish radial patches. Pamban.

Order Stylommatophora.

SERIES ONCHIDIACEA.

Family ONCHIDIIDAE.

This family includes naked marine molluscs in which the shell is absent altogether. The dorsal surface is more or less convexly arched. The mantle is thick and usually beset with tough warts bearing small branchial tufts, and sometimes also set with "eyes". The body is ovate in outline, and the foot is more or less elongated. The head bears a pair of eye-bearing tentacles.

A single species belonging to the genus *Onchidium* is recorded from Pamban.

Genus **Onchidium** Buchanan, 1800.

(Syn. **Peronia** Blainville, 1824).

The foot is broader than the margin of the body; the head is large and the body ovoid and inflated, without large marginal glands. The dorsum generally bears eyes and, sometimes branchial processes.

Onchidium verruculatum Cuvier.

Plate XXXIV, figs. 3*a* to 3*f*.

Onchidium verruculatum, Cuvier, Règne Animal, Ed II, Vol. III, 1830, p 46 (foot-note), and Desciple's edition Mollusca, p. 69 (foot-note).

Onchidium verruculatum, Bretnall, Onchidiidae, Rec. Australian Mus., XII, 1919, p. 309.

Onchidium verruculatum, Farran, in Herdman, Ceylon Pearl Oyster Fisheries Suppl. Report, Opisthobranchiata, III, 1905, Appendix, p. 358, pl. vi, figs 13—22.

Onchidium verruculatum, Arey & Crozier, "On the Natural History of *Onchidium verruculatum*", J. Exp. Zool, XXXII, 1921, p. 443.

This species is very widely distributed in the Indian and Pacific oceans and is represented in the collection by three well preserved specimens from Krusadai Island. The animal is fairly large, the largest of the three measuring 48 mm. long, 29 mm. wide and 25 mm. high ; the other two specimens are slightly shorter and flatter but relatively broad ; the differences in the proportions of the length and width in these specimens are apparently due to varying degrees of contraction and effects of pressure during preservation. The sole of the foot measures 46 mm. long and 25 mm. wide in the large specimen, but only about 29 mm. long and 18 mm. wide in the smaller ones ; the present specimens are therefore noticeably larger than the single specimen from the Gulf of Manaar, examined by Farran. The animal is elongately ovate in outline with a very tough and leathery integument, a convexly arched dorsum, and well developed, elongated foot with a flat, creeping sole. The dorsal surface is completely covered with tough, warty tubercles, of both simple and compound types, and of varying sizes. The simple tubercles are far more abundant than the compound ones, which are just close aggregations of about 5—7 simple tubercles. Towards the posterior margin of the back (occupying about a fifth of the body length) there are about a dozen, somewhat closely spaced, large, tufted branchial tubercles, each of which is made up of numerous short papillae, closely crowded together ; these papillae are said to be extensile during life. On the remaining four-fifths of the dorsal surface there are 12—15 large, rounded ocular tubercles scattered at rather wide and irregular intervals, but Farran reports only six of them in the Ceylon specimen ; they bear from 2—8 ocelli each, on a smooth, pale area on the summit. The head is large and rounded, and placed between the edges of the foot and the mantle at the anterior end. The mouth is a small vertical slit placed on the lower surface of the head. There are two tentacles, widely separated, but have badly contracted in the present specimens. The sole of the foot is strongly transversely wrinkled. The preserved specimens are rather faded ; the dorsal surface is dirty greyish, with irregular, dark purplish brown blotches and the ventral surface is pale yellowish grey, except the area adjoining the foot where it is dark grey. A coloured sketch of the ventral aspect of the animal shows the sole of the foot to be pale greenish, the region all round adjoining it dark greyish green and the periphery pale ashy blue. The radula is pale yellow, translucent and made up of 60 rows of teeth. The animals are occasionally seen sticking to rocks among weeds on the reefs. Krusadai Island.

SERIES HELICACEA.

Family PLEURODONTIDAE.

The shell is variously shaped, with or without an umbilicus; lenticular, elongately ovoid or turretted. The aperture sometimes bears teeth or ridges and the outer lip is as a rule expanded or reflected out. The jaws are ridged or smooth.

A single genus, *Planispira*, is represented.

Genus **Planispira** Beck, 1837

The shell is as a rule umbilicated, and the spire is very slightly raised; the embryonic shell is not granulated or striated. The lower surface of the body whorl is convexly arched. The aperture is more or less oblique.

Two species, *P. vittata* and *P. fallaciosa*, have been recorded from Pamban. In the former, the shell is larger, not much depressed, with a moderately convex spire and the umbilicus is rather small and partly shut in by a callus-bearing fold of the columella; while in the latter, which is much commoner, the shell is smaller, more strongly depressed and lens-shaped with an almost flattened spire, and the umbilicus is relatively large and more or less completely open.

Planispira fallaciosa (Férussac)

Plate XXXIV, figs. 5*a* and 5*b*.

Helix (Helicella) fallaciosa, Férussac, Tabl Syst Limaçons, 1821, p. 43 (nom. nud.).
Helix fallaciosa, Pfeiffer, Symb. Hist. Helic., II, 1842, p. 27.
Helix fallaciosa, Reeve, Conch. Icon, VII, 1852, *Helix*, pl. 85, fig. 459.
Helix (Planispira) fallaciossa, Nevill, Handlist of Moll. Ind. Mus., pt. 1, 1878, p. 77.
Planispira (Trachia) fallaciosa, Pilsbry, Man Conch, ser 2, IX, 1894, p. 116.
Trachia fallaciosa, Jousseaume, Mem Soc. Zool. France, VII, 1894, p 285.
Planispira fallaciosa, Gude, Fauna of British India, Mollusca, II, 1914, p. 157.

A few empty shells from Pamban are represented in the collection. They are generally found washed up on the sand far in the interior, away from the open sea, as they are backwater forms. The shell is depressed and more or less lenticular, with a flattened spire, the apex of which is scarcely raised above the general level of the whorls. The sutures appear as well impressed grooves. The surface of the whorls is finely transpirally striated, and very minutely punctured all over. The whorls are very slightly convexly raised above, and the peripheral portion of the body whorl is sharply but evenly rounded. The basal surface of the body whorl is strongly convex and more or less angular adjacent to the umbilicus. The body whorl is expanded towards the aperture which is strongly oblique and ovately rounded; the outer lip of the aperture is slightly thickened and reflected out, and on the columellar side the margins of the aperture approach each other and are united by a thin sheet of callus; the basal margin

of the aperture is nearly straight; the columellar part of the outer lip slightly overhangs the umbilicus. The umbilicus is large, circular and perspective. The shell is whitish or pale horny brown with dark brown spiral bands just below the sutures, and one just above the periphery, followed by two or more narrower ones below. The shells are about 12 mm. wide and 7 mm. high on the average. Pamban.

Planispira vittata (Muller).

Plate XXXIV, fig. 4.

Helix vittata, Muller, Verm. terr. fluv., II, 1774, p. 76.
Helix vittata, Wood, Index Test., 1825, pl. 34, fig. 93.
Helix vittata, Adams & Reeve, Zoology of the "Samarang," 1850, Mollusca, p. 60, pl. xv, figs. 7 *a*, *b* and *c*.
Helix vittata, Reeve, Conch Icon., VII, 1852, *Helix*, pl. 78, fig. 412.
Helix (Planispira) vittata, Nevill, Handlist of Moll. Ind Mus., pt. 1, 1878, p 76.
Planispira (Trachia) vittata, Pilsbry, Man Conch, ser 2, IX, 1894, p. 115 (anatomy); p. 116, pl ix, fig. 24, (shell).
Helix (Eurystoma) vittata, Godwen Austen, Proc. Malac Soc., VI, 1904, p. 48, pl 4.
Planispira vittata, Gude, Fauna of British India, Mollusca, II, 1914, p. 165.

The shell is larger, thicker and more solid than in the preceding species and is much less strongly depressed, the spire being distinctly convex. The uppermost whorls of the spire are smooth and glossy, and somewhat blackish or smoky brown, but the rest of the surface is finely transpirally striated and minutely granulated all over. The sutures are impressed and the apex obtusely rounded. The body whorl is somewhat inflated and its basal surface evenly rounded and swollen; it is considerably widened towards the aperture which is strongly oblique, but of greater vertical extent than in the preceding species. The outer lip is rather widely expanded and reflected at the margin; its basal margin is nearly straight while the outer and upper margins are curved. The umbilicus is small and appears as a deep, narrowly circular opening. The columellar margin is expanded into a distinct sheet of callus which overhangs the umbilical opening considerably on that side. The shell is whitish, ornamented irregularly with pale brownish bands of varying widths. The interior of the aperture is dark horny brown. Only a single shell is contained in the collection, it measures 21 mm. broad and 14 mm. high. Pamban.

REFERENCES TO LITERATURE FOR AMPHINEURA AND GASTROPODA.

NOTE.—The following list includes most of the better known standard works on the subject, as well as a selection of some of the more important papers appearing in various periodical publications, and referred to in the present volume. For other references the reader is referred to the lists of references prefixed to the descriptions of the various species recorded in this paper.

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PLATES

NOTE.—All the illustrations are drawn to natural size, except where otherwise stated; wherever figures are drawn enlarged, the magnifications are indicated either by a line drawn by the side of the figure, representing the natural size of the subject, or by numbers suffixed to the explanations of the corresponding species.

PLATE I.

Fig. 1. *Craspedochiton laqueatus* (Sowerby).
„ 2. *Acanthochitona mahensis* Winckworth.
„ 3*a*. *Ischnochiton herdmani* Sykes.
„ 3*b*. The two terminal and one of the median shell plates of *Ischnochiton herdmani*, detached and slightly enlarged.
„ 4. *Ischnochiton aequigranulatus* von Knorre.
„ 5. *Ischnochiton comptus* Gould.
„ 6. *Tonicia pectinoides* Sykes.
„ 7*a*. *Haliotis varia* Linné: dorsal view of shell.
„ 7*b*. *Haliotis varia* Linné: ventral view of shell with the animal *in situ*.
„ 8. *Diodora funiculata* (Reeve).
„ 9. *Diodora lima* (Sowerby).
„ 10. *Diodora bombayana* (Sowerby); small portion of surface of shell magnified to show details of sculpture.
„ 11. *Diodora ticaonica* (Reeve).
„ 12. *Emarginula obovata* A. Adams.
„ 13*a*. *Scutus unguis* (Linné): outer aspect of shell.
„ 13*b*. *Scutus unguis* (Linné): inner aspect of shell showing the mantle groove or impression.
„ 14*a*. *Cellana radiata* (Born): dorsal view of shell.
„ 14*b*. *Cellana radiata* (Born): side view of shell.

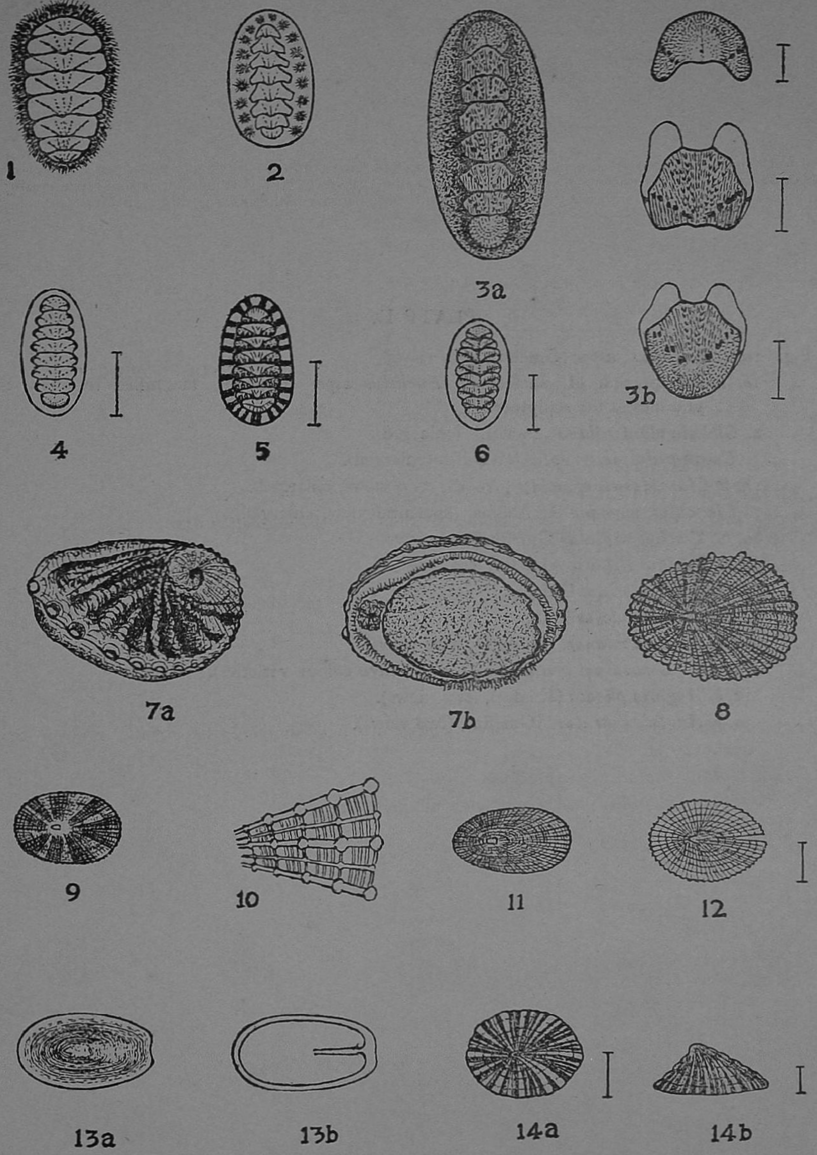
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PLATE II.

Fig. 1*a*, *c*. *Euchelus asper* (Gmelin), (two views).

" 1*b*. Small portion of surface of *Euchelus asper* (Gmelin), magnified to show the granules of the sculpture.

" 2. *Gibbula blanfordiana* Nevill, (enlarged).

" 3. *Cantharidus interruptus* (Wood), (enlarged).

" 4*a*, *b* *Clanculus clanguloides* (Wood), (two views, enlarged).

" 5. *Clanculus microdon* A. Adams, (apertural view, enlarged).

" 6*a*, *b*. *Trochus radiatus* Gmelin, (two views).

" 7*a*, *b*. *Trochus stellatus* Gmelin, (two views).

" 8. *Trochus tentorium* Gmelin.

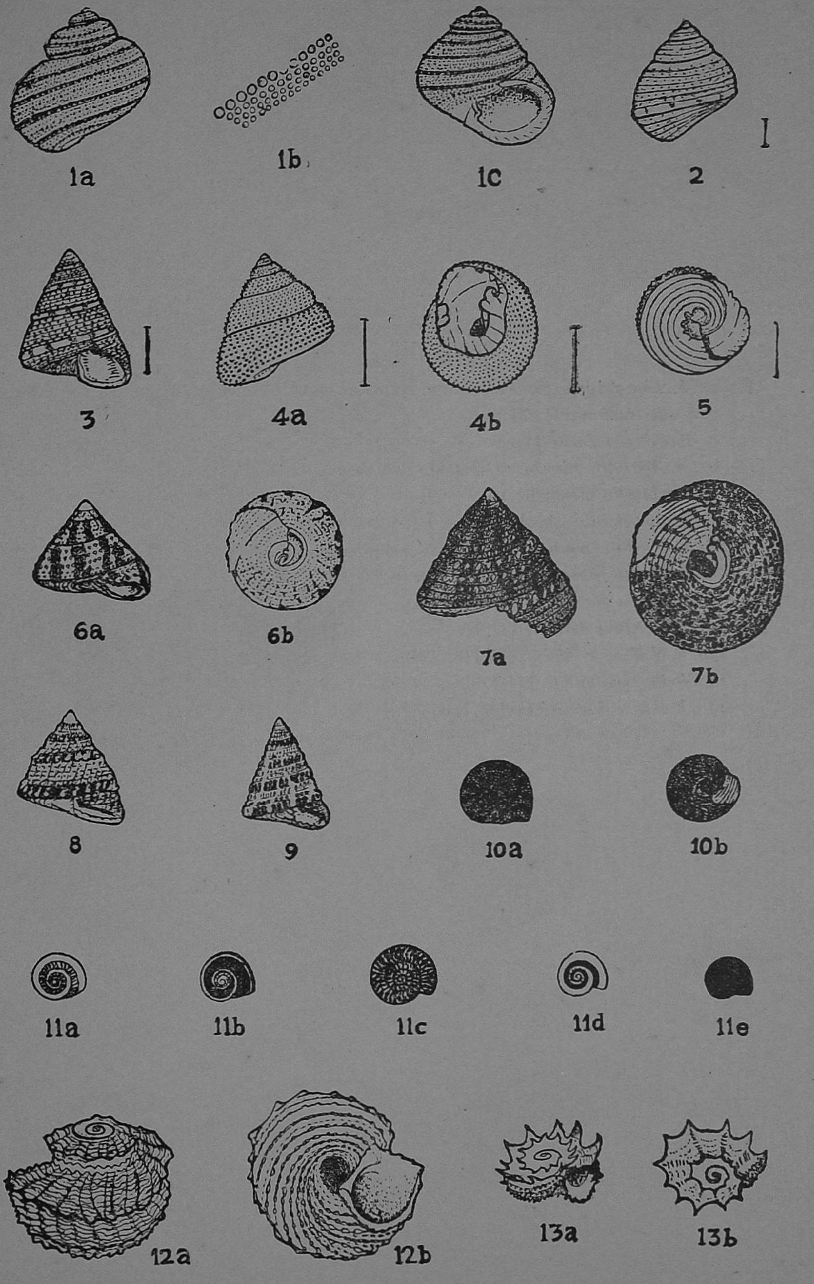
" 9. *Trochus pustulosus* Philippi.

" 10*a*, *b*. *Monilea solandri* (Philippi), (two views).

" 11*a* to *e*. *Umbonium vestiarium* (Linné), (five colour varieties).

" 12*a*, *b*. *Angaria plicata* (Kiener), (two views).

" 13*a*, *b*. *Angaria atratus* (Gmelin), (two views).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11e
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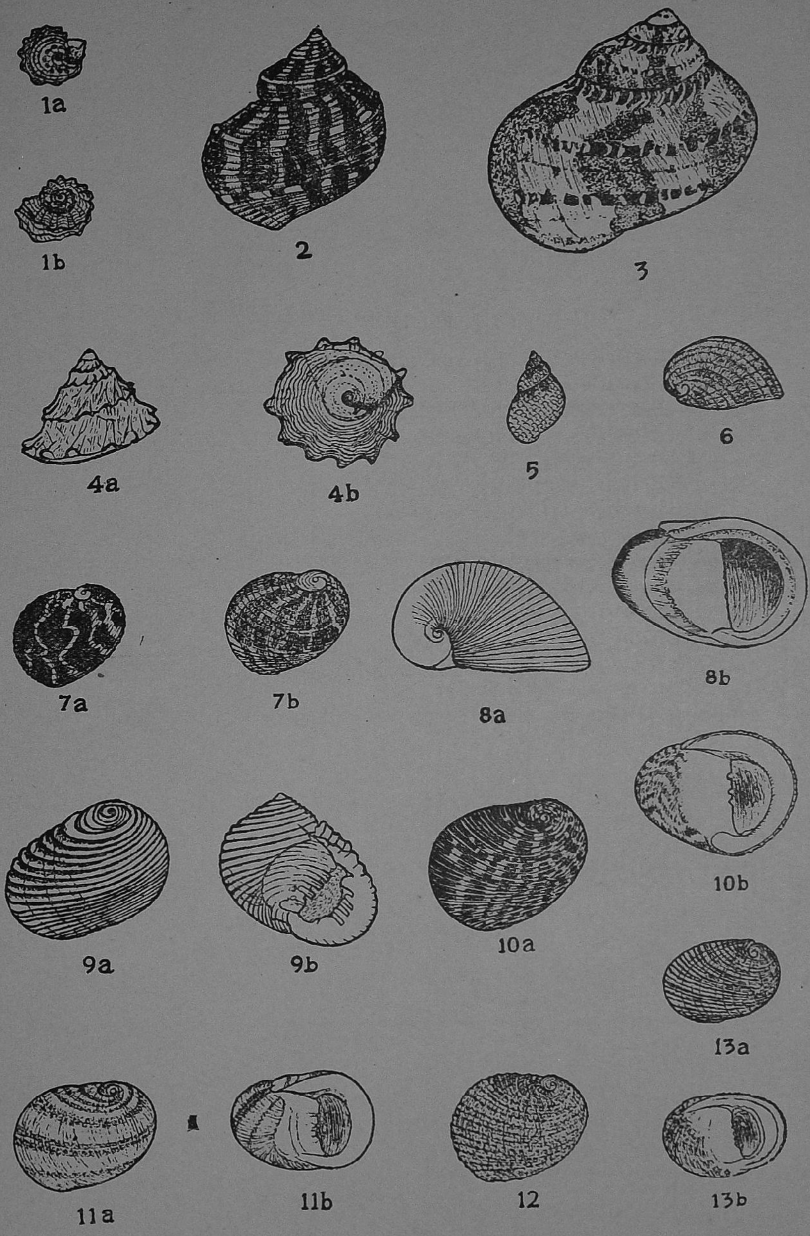
12b
13a
13b

PLATE III.

Fig. 1*a*, *b*. *Liotia cidaris* (Reeve), (two views).
" 2. *Turbo intercostalis* Menke.
" 3. *Turbo petholatus* Linné.
" 4*a*, *b*. *Astraea semicostata* (Kiener), (two views).
" 5. *Phasianella nivosa* Reeve.
" 6. *Nerita albicilla* Linné.
" 7*a*, *b*. *Nerita chameleon* Linné, (two colour varieties).
" 8*a*, *b*. *Nerita polita* Linné, (two views).
" 9*a*, *b*. *Nerita plicata* Linné, (two views).
" 10*a*, *b*. *Nerita maura* Récluz, (two views).
" 11*a*, *b*. *Nerita rumphii* Récluz, (two views).
" 12. *Nerita squamulata* Le Guillou.
" 13*a*, *b*. *Nerita dombeyi* Récluz, (two views).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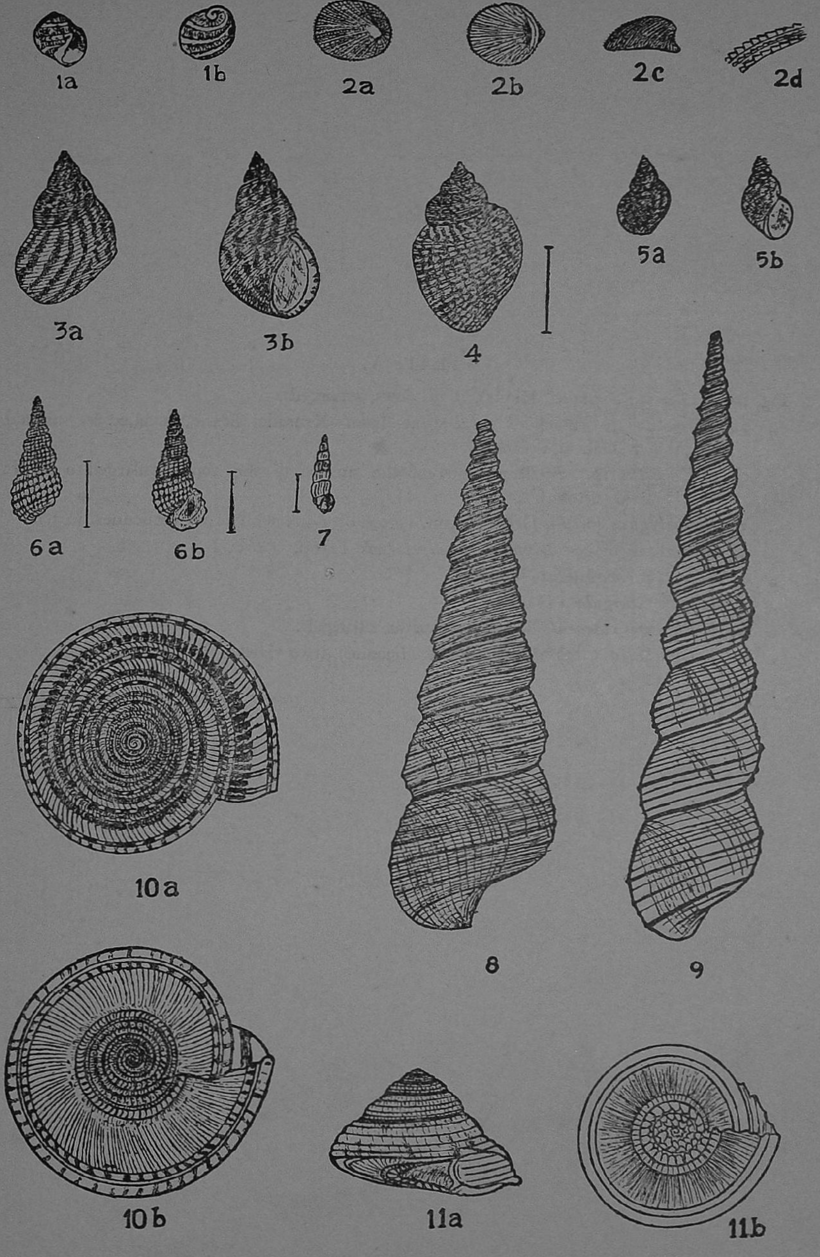
13a
13b

PLATE IV.

Fig. 1*a*, *b*, *Neritina oualaniensis* Lesson, (two views).
" 2*a*, *b* *Phenacolepas asperulata* (Chemnitz), (outer and inner aspects of the shell).
" 2*c* *Phenacolepas asperulata* (Chemnitz), (side view).
" 2*d*. *Phenacolepas asperulata* (Chemnitz), (small portion of surface magnified).
" 3*a*, *b* *Littorina scabra* Linné, (two views).
" 4. *Littorina subgranosa* Dunker, (enlarged).
" 5*a*, *b*. *Littorina undulata* Gray, (two views).
" 6*a*, *b* *Rissoina clathrata* A. Adams, (two views, enlarged).
" 7. *Rissoina bertholleti* Issel, (enlarged).
" 8. *Turritella acutangula* (Linné).
" 9. *Turritella attenuata* Reeve.
" 10*a*, *b*. *Architectonica perspectiva* (Linné), (two views).
" 11*a*, *b*. *Architectonica laevigata* (Lamarck), (two views).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2d
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4
5a
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9
10b
11a
11b

PLATE V.

Fig. 1*a*, *b*. *Torinia dorsuosa* (Hinds), (two views, enlarged).

" 2*a*. *Vermetus sp*. (block of coral stone from Krusadai Island, invaded by numerous tubular shells of *Vermetus*).

" 2*b*, *c*. *Vermetus sp*. Small portions of the surface of the above, enlarged to show the individual tubes.

" 3*a*. *Spiroglyphus spirulaeformis* Tryon, (piece of stone with tubes embedded in it).

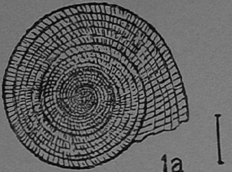
" 3*b*. Operculum of *Spiroglyphus spirulaeformis* Tryon, × 10.

" 4. *Tenagodus encausticus* (Morch).

" 5. *Melania tuberculata* (Muller).

" 6*a*, *b*. *Planaxis sulcatus* (Born), (two views, enlarged).

" 7*a*, *b*. *Cerithidea fluviatilis*, (Potiéz & Michaud), (two views).



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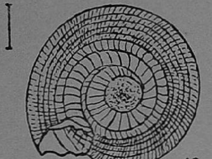

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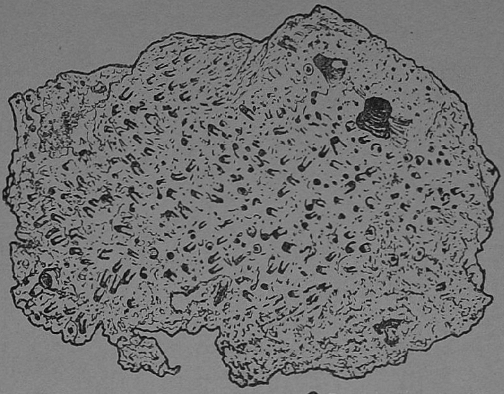

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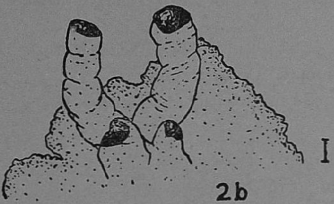

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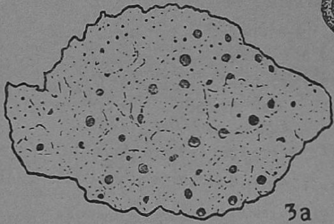

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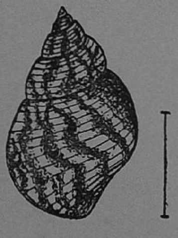

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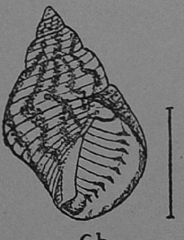


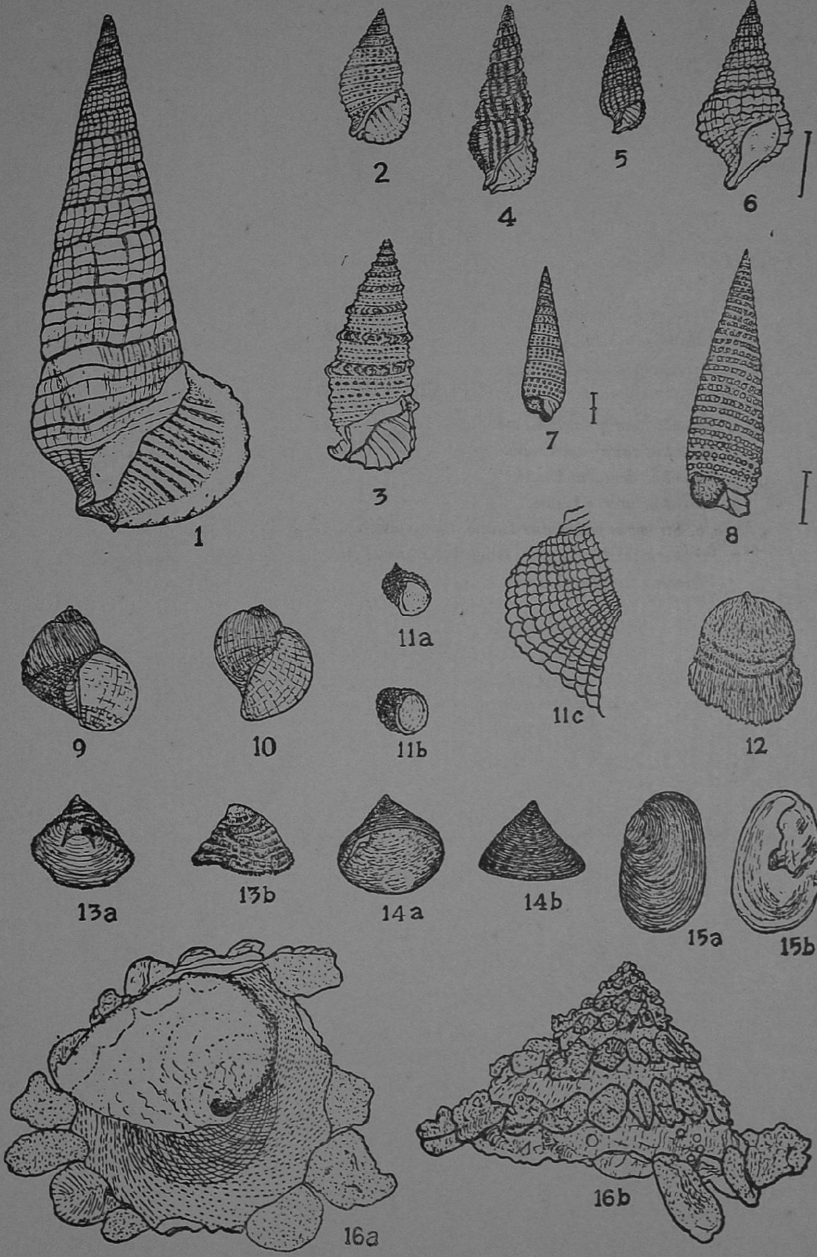
6b

7a

7b

PLATE VI.

Fig. 1. *Terebralia palustris* (Linné).
„ 2. *Cerithium morus* Lamarck.
„ 3. *Cerithium obeliscus* Bruguière.
„ 4. *Cerithium citrinum* Sowerby.
„ 5. *Cerithium scabridum* Philippi.
„ 6. *Cerithium splendens* Sowerby, (enlarged).
„ 7. *Triphora concinna* Hinds, (enlarged).
„ 8. *Triphora violacea* (Quoy & Gaimard), (enlarged).
„ 9. *Janthina roseola* Reeve.
„ 10. *Janthina globosa* Swainson.
„ 11*a*, *b*. *Vanikoro granulosa* (Récluz), (two views from the apertural side).
„ 11*c*. Portion of the surface of *Vanikoro granulosa* (Récluz), enlarged, showing the sculpture in detail.
„ 12. *Cheilea equestris* (Linné).
„ 13*a*, *b*. *Cheilea undulata* (Röding), (two views).
„ 14*a*, *b*. *Calyptraea* (*Crucibulum*) *extinctorium* Lamarck, (two views).
„ 15*a*, *b*. *Crepidula walshi* Hermannson, (two views).
„ 16*a*, *b*. *Xenophora corrugata* (Reeve), (two views).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16b

PLATE VII.

Fig. 1. *Strombus marginatus* Linné.

" 2. *Strombus canarium* Linné.

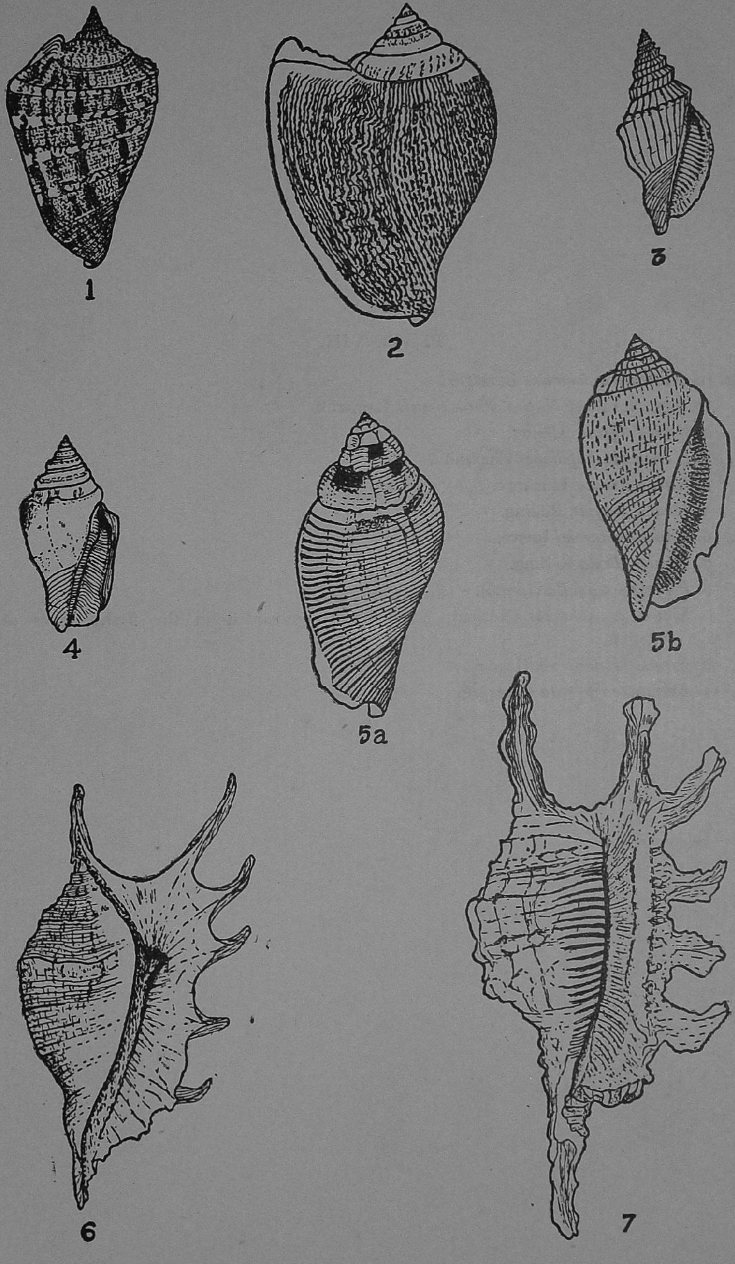
" 3. *Strombus dentatus* Linné.

" 4. *Strombus urceus* Linné.

" 5 *a, b. Strombus gibberulus* Linné, (two views).

" 6. *Pterocera lambis* (Linné), (slightly reduced).

" 7. *Pterocera scorpius* (Linné).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5a
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PLATE VIII.

Fig. 1*a*. *Natica marochiensis* Lamarck.

„ 1*b*. Egg capsule of *Natica marochiensis* Lamarck.

„ 2. *Natica tigrina* Roding.

„ 3. *Natica ala-papiliones* Chemnitz.

„ 4. *Natica lineata* Lamarck.

„ 5. *Natica didyma* Roding.

„ 6. *Natica lamarckii* Reeve.

„ 7. *Natica albula* Roding.

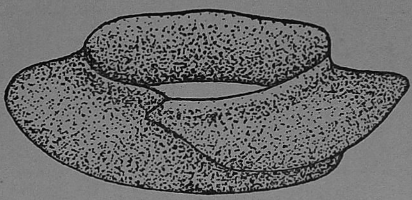
„ 8. *Polynices mamilla* (Linné).

„ 9. *Sinum planulatum* (Récluz), (shell partly embedded in the fleshy lobes of the mantle).

„ 10. *Sinum neritoideum* (Linné).

„ 11. *Eunaticina papilla* (Gmelin).

1a



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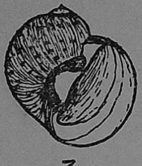

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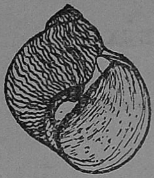

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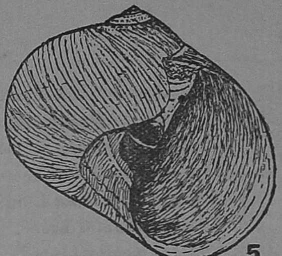

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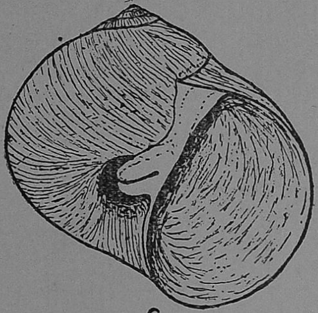

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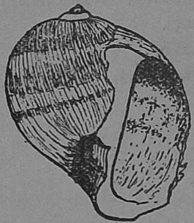

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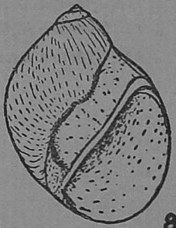

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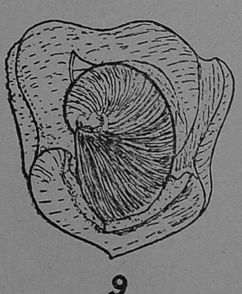

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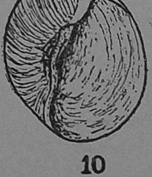
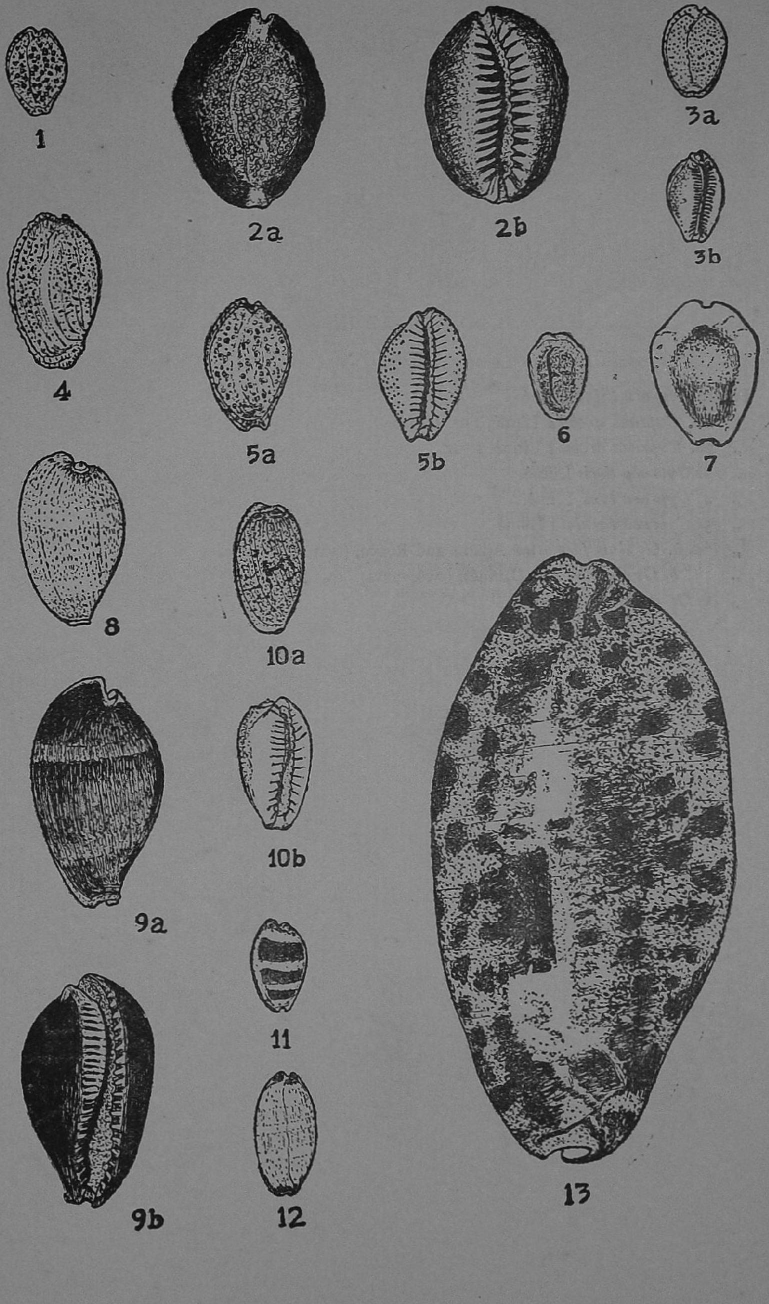


10

11

PLATE IX.

Fig. 1. *Cypraea staphylaea* Linné.
„ 2*a*, *b*. *Cypraea caput-serpentis* Linné, (two views).
„ 3*a*, *b*. *Cypraea poraria* Linné.
„ 4. *Cypraea erosa* Linné.
„ 5*a*, *b*. *Cypraea ocellata* Linné.
„ 6. *Cypraea annulus* Linné.
„ 7. *Cypraea moneta* Linné.
„ 8. *Cypraea pallida* Gray.
„ 9*a*, *b*. *Cypraea onyx* Linné, (two views).
„ 10*a*, *b*. *Cypraea errones* Linné, (two views).
„ 11. *Cypraea asellus* Linné.
„ 12. *Cypraea isabella* Linné.
„ 13. *Cypraea testudinaria* Linné.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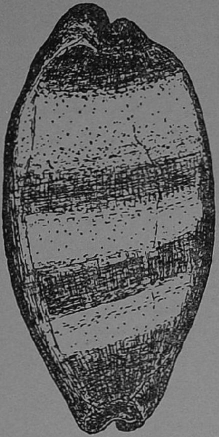
9b

PLATE X.

Fig. 1. *Cypraea talpa* Linné.
„ 2*a*. *Cypraea arabica* Linné, *var. histrio.*
„ 2*b*. *Cypraea arabica* Linné, *s. str.*
„ 3. *Cypraea tigris* Linné.
„ 4. *Cypraea lynx* Linné.
„ 5. *Cypraea carneola* Linné.
„ 6*a*, *b*. *Ovulum formosum* Adams and Reeve, (two views).
„ 7*a*, *b*. *Ovulum birostre* (Linné), (two views).
„ 8. *Ovulum volva* (Linné).



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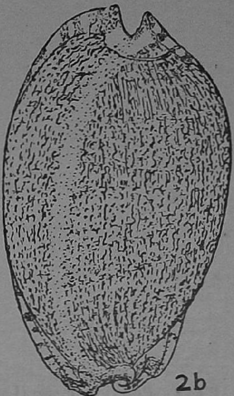

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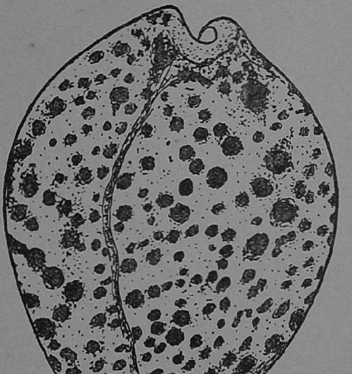

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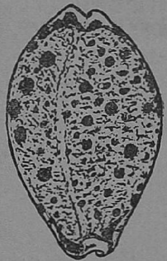

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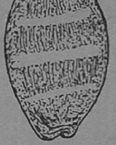

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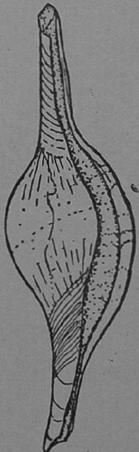
6a

6b

7a

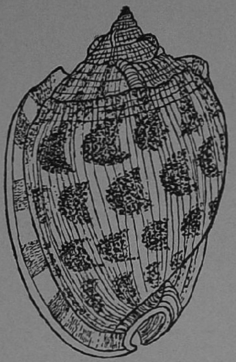
7b



8

PLATE XI.

Fig. 1. *Phalium areola* (Lamarck).
„ 2. *Phalium glaucum* (Linné).
„ 3. *Phalium canaliculatum* (Bruguière).
„ 4. *Phalium bisulcatum* (Schubert and Wagner).
„ 5. *Phalium ponderosum* (Gmelin).
„ 6. *Gyrineum natator* (Röding).
„ 7*a*, *b*. *Cymatium pileare* (Linné), (two views).



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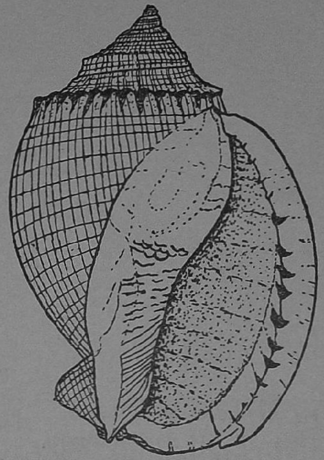

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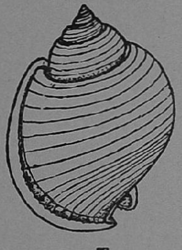

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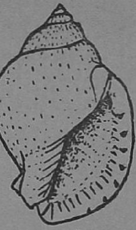

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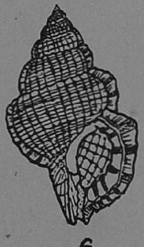

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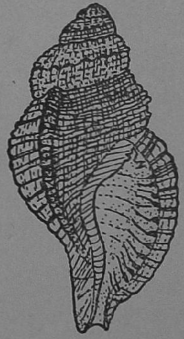
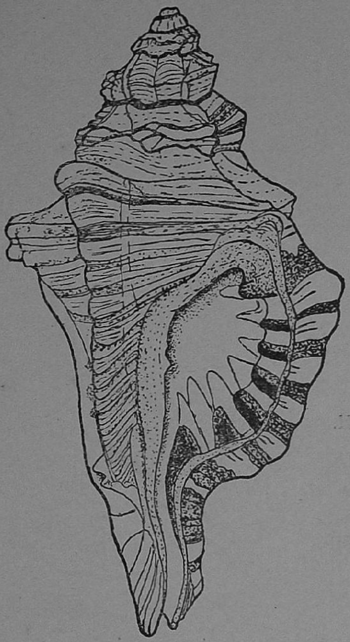


7b

PLATE XII.

Fig. 1. *Cymatium rhinoceros* (Lamarck).
„ 2*a*, *b*. *Cymatium cingulatum* (Lamarck), (two views).
„ 3*a*, *b*. *Bursa granularis* (Roding), (two views).
„ 4. *Bursa spinosa* (Lamarck).
„ 5. *Bursa rubeta* (Linné).
„ 6*a*, *b*. *Bursa margaritula* (Deshayes), (two views).

PLATE XII.



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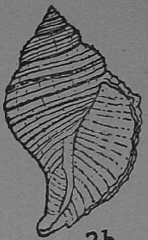

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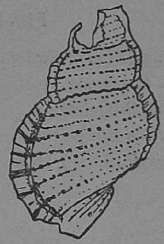

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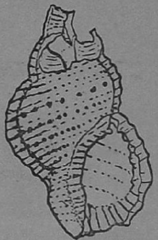

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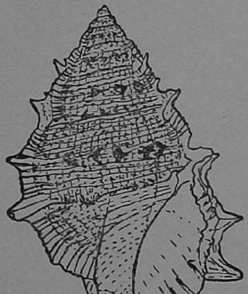

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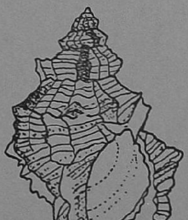

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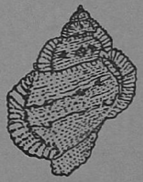

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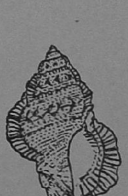
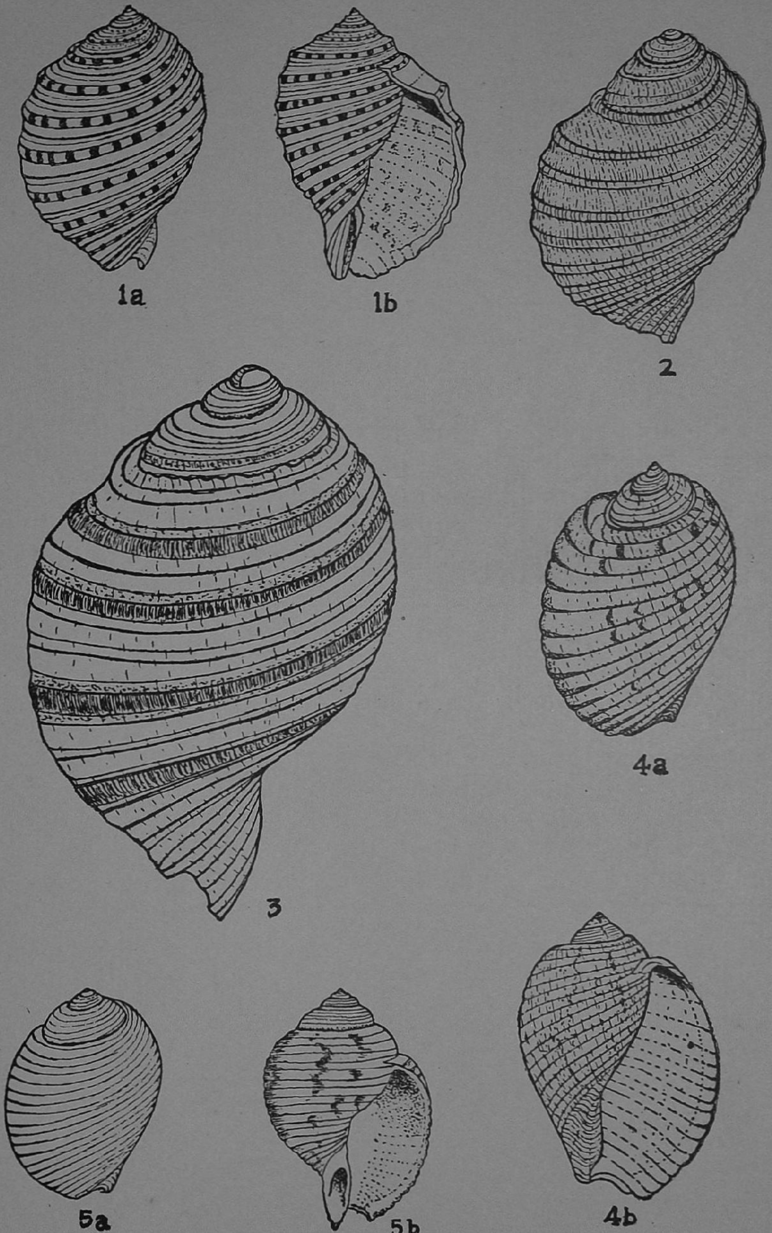


6b

PLATE XIII.

Fig. 1*a*, *b*. *Tonna dolium* (Linné), (two views).
„ 2. *Tonna tessellata* (Lamarck).
„ 3. *Tonna fasciatum* (Bruguière).
„ 4*a*, *b*. *Tonna olearium* (Bruguière), (two views).
„ 5*a*, *b*. *Tonna cumingii* (Reeve), (two views).


1a
1b
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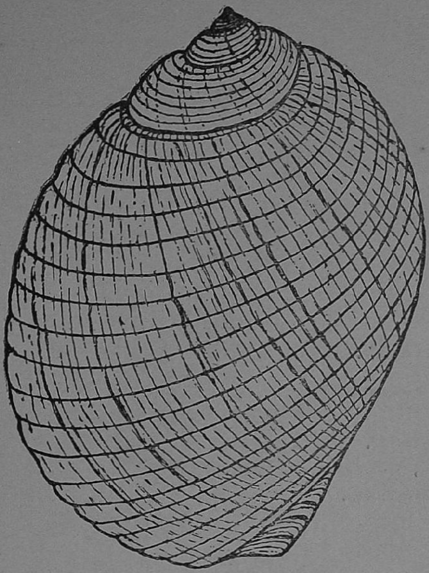
4a
5a
5b
4b

PLATE XIV.

Fig. 1. *Tonna perdix* (Linné).
,, 2*a*, *b*. *Rapana bulbosa* (Solander), (two views).
,, 3*a*, *b*. *Murex badius* Reeve, (two views).
,, 4. *Murex trapa* Röding.
,, 5. *Murex haustellum* Linné.



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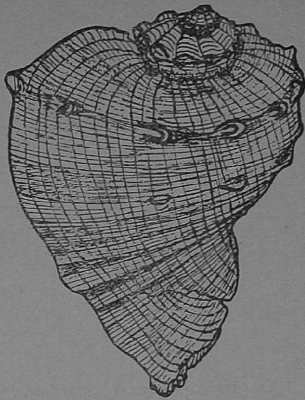

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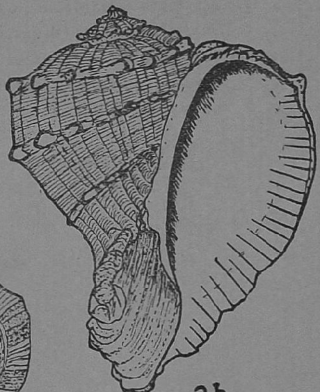

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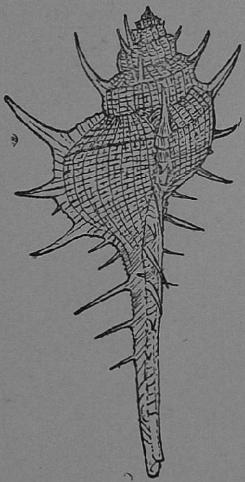

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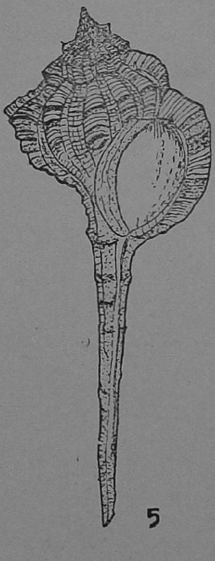


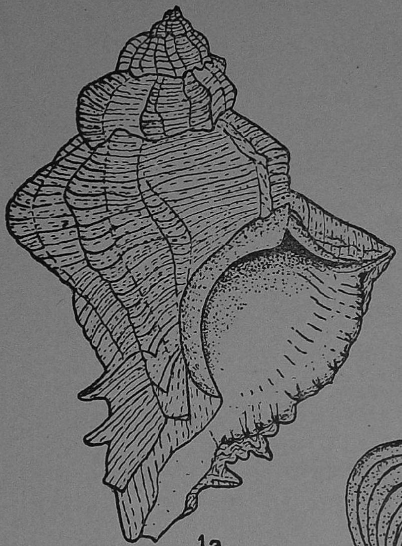
5

3a

3b

PLATE XV.

Fig. 1 *a*. *Murex virgineus var. ponderosa* Sowerby.
,, 1*b*. Operculum of the above.
,, 2*a*, *b*. *Murex adustus* Lamarck, (two views).
,, 3*a*, *b*. *Drupa margariticola* (Broderip), (two views).
,, 4*a*, *b*. *Drupa heptagonalis* (Reeve), (two views).
,, 5. *Drupa tuberculata* (Blainville).
,, 6*a*, *b*. *Drupa horrida* (Lamarck), (two views).
,, 7. *Maculotriton serrialis* (Laborde).
,, 8. *Jopas sertum* (Bruguière).



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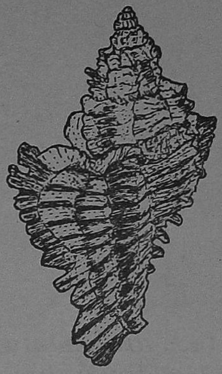

2a

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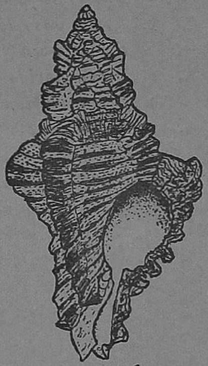

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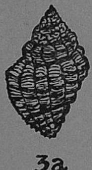

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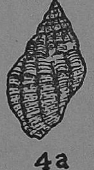

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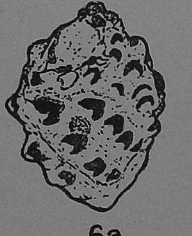

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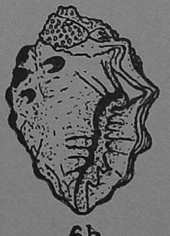

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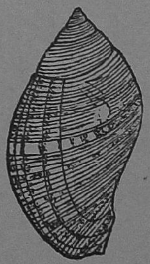

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7

PLATE XVI.

Fig. 1. *Thais rudolphi* (Lamarck).
,, 2. *Thais bufo* (Lamarck), (with operculum *in situ*).
,, 3. *Thais rugosa* (Born).
,, 4. *Thais tissoti* (Petit).
,, 5. *Thais intermedia* (Kiener).
,, 6. *Pyrene versicolor* (Sowerby).
,, 7. *Pyrene zebra* (Gray).
,, 8. *Pyrene flavida* (Lamarck).
,, 9. *Pyrene vulpecula* (Sowerby).
,, 10. *Engina zonata* (Reeve), (enlarged).
,, 11. *Engina trifasciata* (Reeve), (enlarged).
,, 12. *Babylonia spirata* (Linné).
,, 13*a*, *b*. *Cantharus undosus* (Linné), (two views).
,, 14*a*, *b*. *Hemifusus pugilinus* (Born), (two views).
,, 14*c*. Operculum of *Hemifusus pugilinus* (Born).

PLATE XVI.

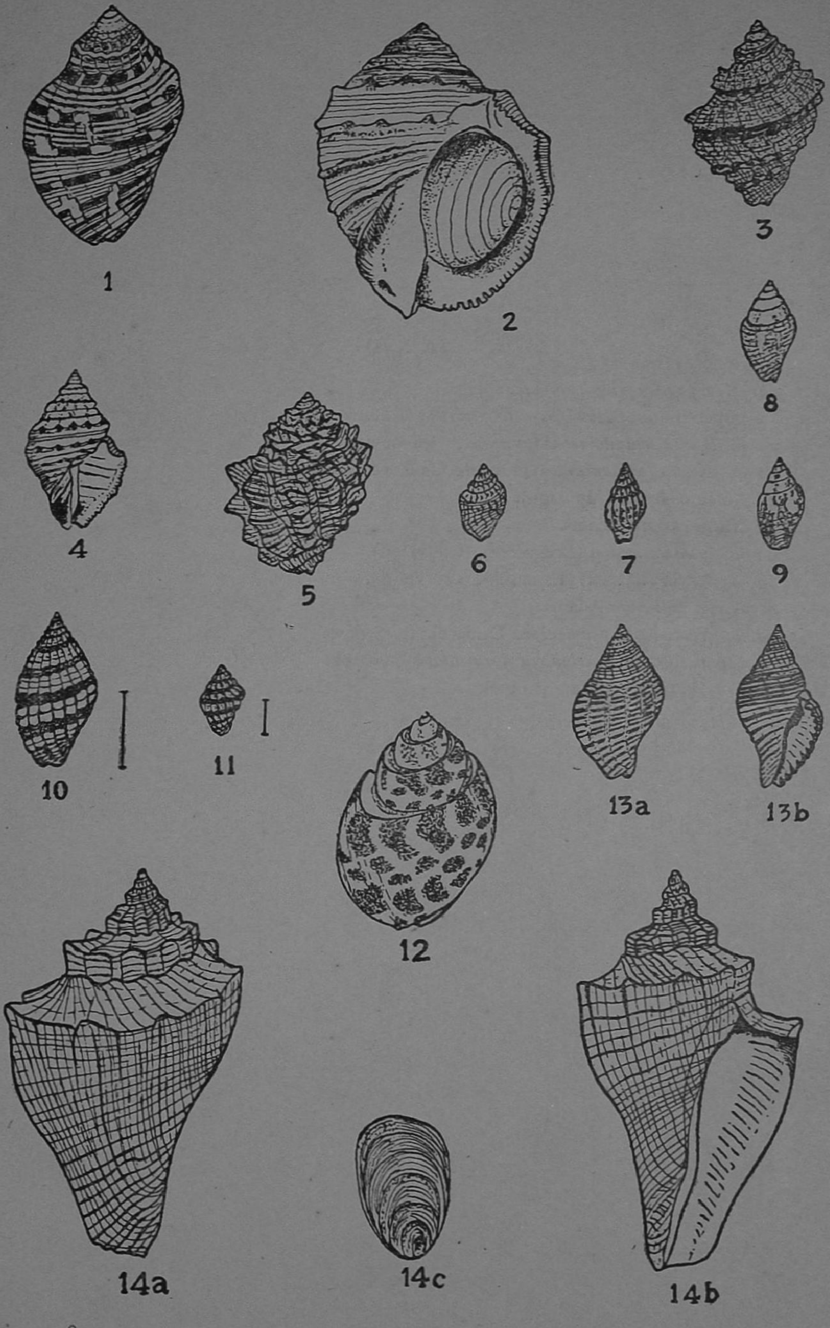

PLATE XVII.

Fig. 1*a*. *Hemifusus cochlidiun* (Linné).

„ 1*b*. Operculum of *Hemifusus cochlidium* (Linné).

„ 2*a*, *b*. *Bullia melanoides* (Deshayes), (two views).

„ 3*a*, *b*. *Nassa jacksoniana* (Quoy and Gaimard), (two views).

„ 4. *Nassa hepatica* (Montagu).

„ 5. *Nassa costata* Adams.

„ 6*a*, *b*. *Nassa thersites* (Bruguière), (two views).

„ 7*a*, *b*. *Nassa suturalis* (Lamarck), (two views).

„ 8. *Nassa pallidula* Adams.

„ 9*a*, *b* *Fasciolaria filamentosa* Lamarck, (two views).

„ 9*c*. Operculum of *Fasciolaria filamentosa* Lamarck.

„ 10. *Fasciolaria trapezium* (Linné).

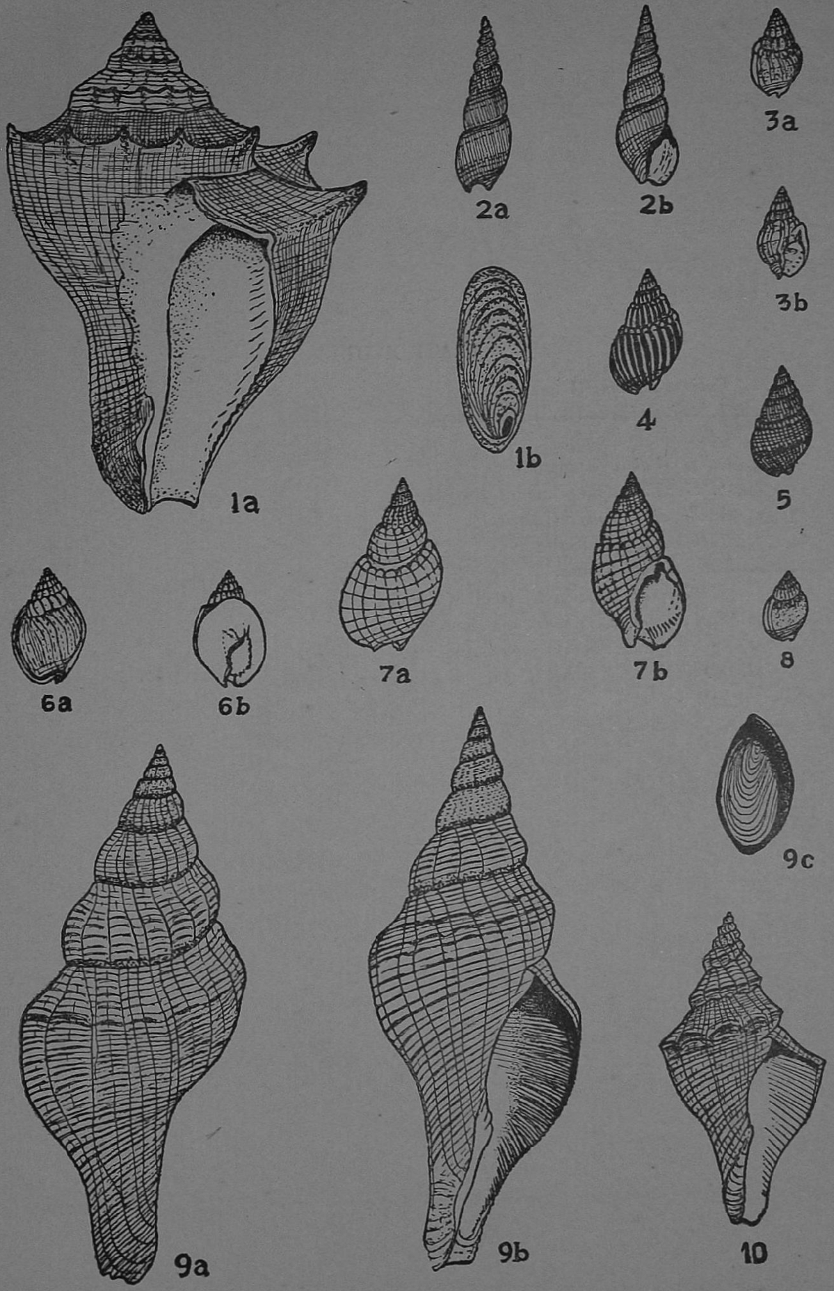
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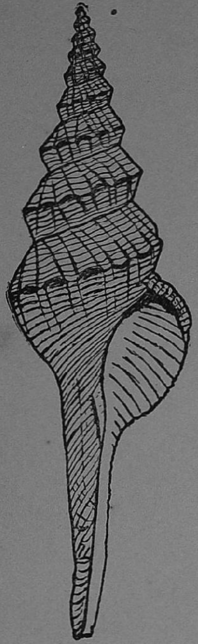
PLATE XVIII.

Fig. 1. *Fusinus toreuma* (Lamarck).
" 2*a*, *b*. *Oliva gibbosa* (Born), (two views).
" 3. *Oliva oliva* (Linné).
" 4. *Oliva nebulosa* (Lamarck).
" 5*a*, *b*. *Ancilla ampla* (Gmelin), (two views).
" 6. *Ancilla cinnamomea* (Lamarck).
" 7. *Ancilla scaphella* (Sowerby).
" 8. *Mitra circula* Kiener.
" 9*a*. *Xancus rapa* (Lamarck), (shell of a young specimen).
" 9*b*. Egg capsule of *Xancus rapa* (Lamarck).
" 9*c*. Operculum of *Xancus rapa* (Lamarck).
" 9*d*. *Xancus rapa* (Lamarck), (shell of an adult specimen).



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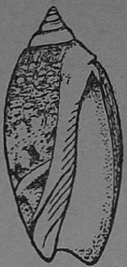

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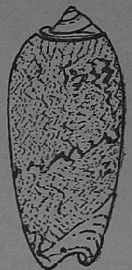

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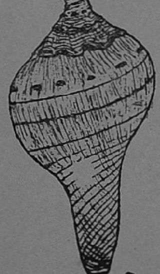

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PLATE XIX.

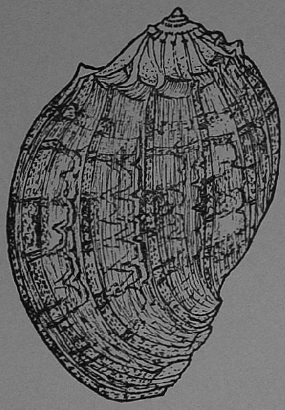
Fig. 1*a*, *b*. *Harpa conoidalis* Lamarck, (two views, fig. 1*b*. being part of the shell showing the columellar area, heavily blotched).

" 2*a*, *b*. *Voluta lapponica* Linné, (two views).

" 3. *Cymbium melo* (Solander), (a half-grown specimen).

" 4. *Brachytoma crenularis* (Lamarck).

" 5*a*, *b*. *Marginella angustata* Sowerby, (two views).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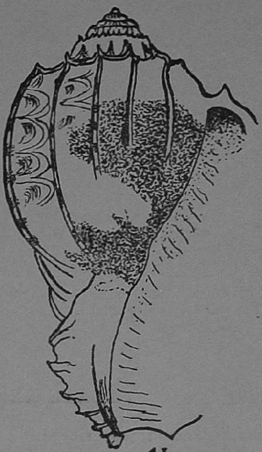
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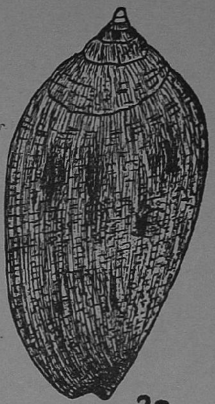
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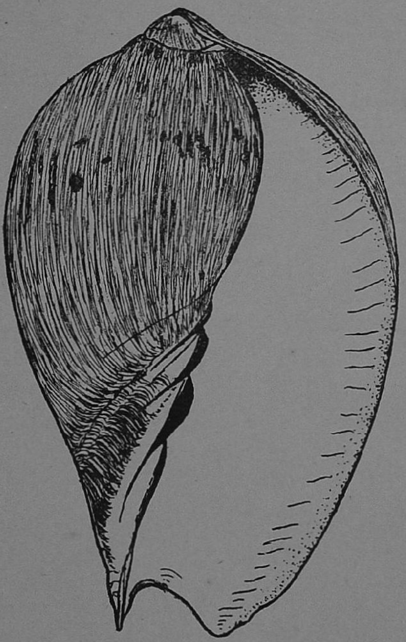
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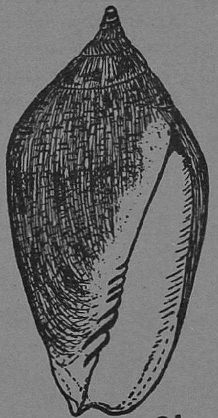
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PLATE XX.

Fig. 1*a*, *b*. *Conus amadis* Gmelin, (two views).
,, 2 *a*, *b*. *Conus punctatus* Chemnitz, (two views).
,, 3. *Conus acuminatus* Bruguière.
,, 4. *Conus coronatus* Dillwyn.
,, 5. *Conus ebraeus* Linné.
,, 6*a*, *b*. *Conus glans* Hwass, (two views).
,, 7. *Conus nussatella* Linné.
,, 8*a*. *Conus geographus* Linné, (young shell).
,, 8*b*. *Conus geographus* Linné, (full-grown shell).

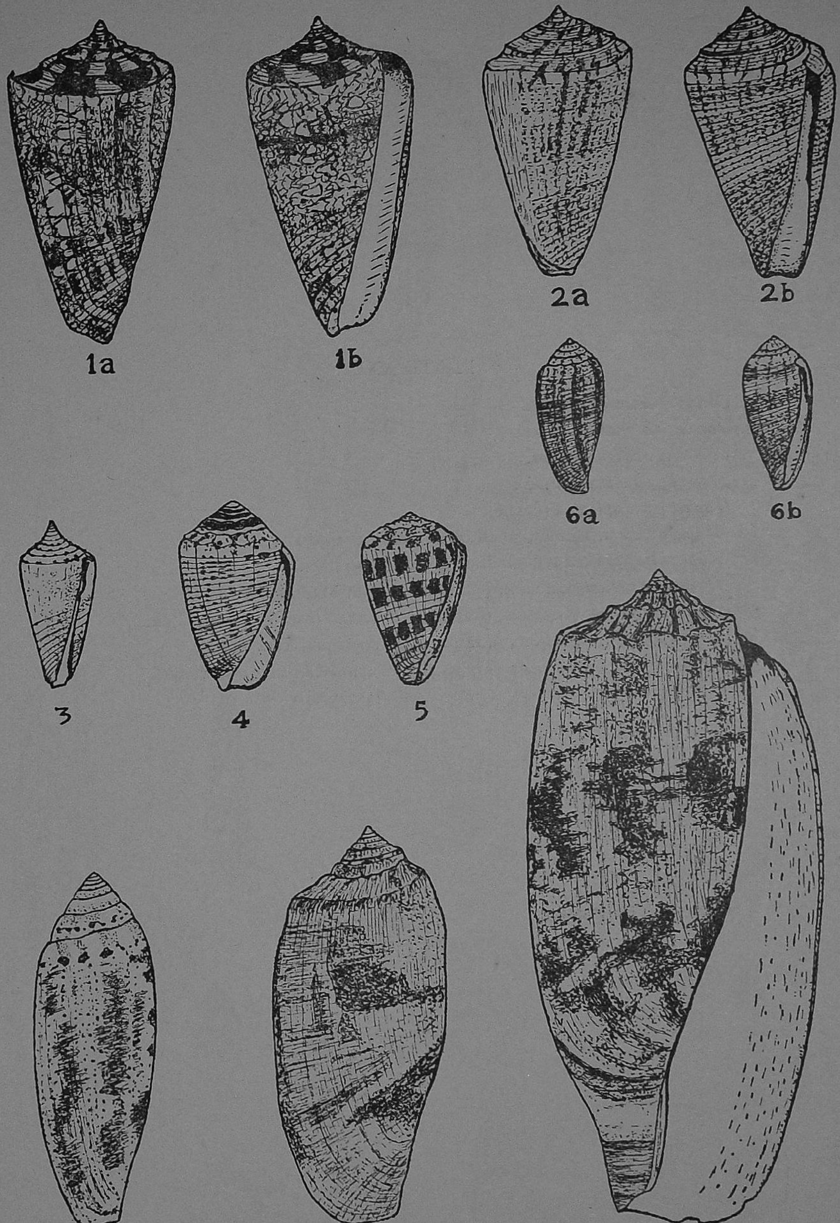
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PLATE XXI.

Fig. 1. *Conus marmoreus* Linné.
,, 2. *Conus gubernator* Hwass.
,, 3. *Conus araneosus* Hwass.
,, 4. *Terebra subulata* (Linné).
,, 5. *Duplicaria duplicata* (Linné).
,, 6*a*. *Pupa solidula* (Linné), (shell of an adult specimen).
,, 6*b*. *Pupa solidula* (Linné), (shell of a young specimen).
,, 7*a*. *Hydatina velum* (Gmelin), (entire shell from Madras).
,, 7*b*. *Hydatina velum* (Gmelin), (fragment of a shell from Kundugal Point).
,, 8*a*, *b*. *Bulla ampulla* Linné, (a rather large specimen, two views).
,, 9*a*, *b*. *Haminoea tenera* (Adams), (shell with animal *in situ*, two views).
,, 9*c*. *Haminoea tenera* (Adams), (empty shell, apertural view).

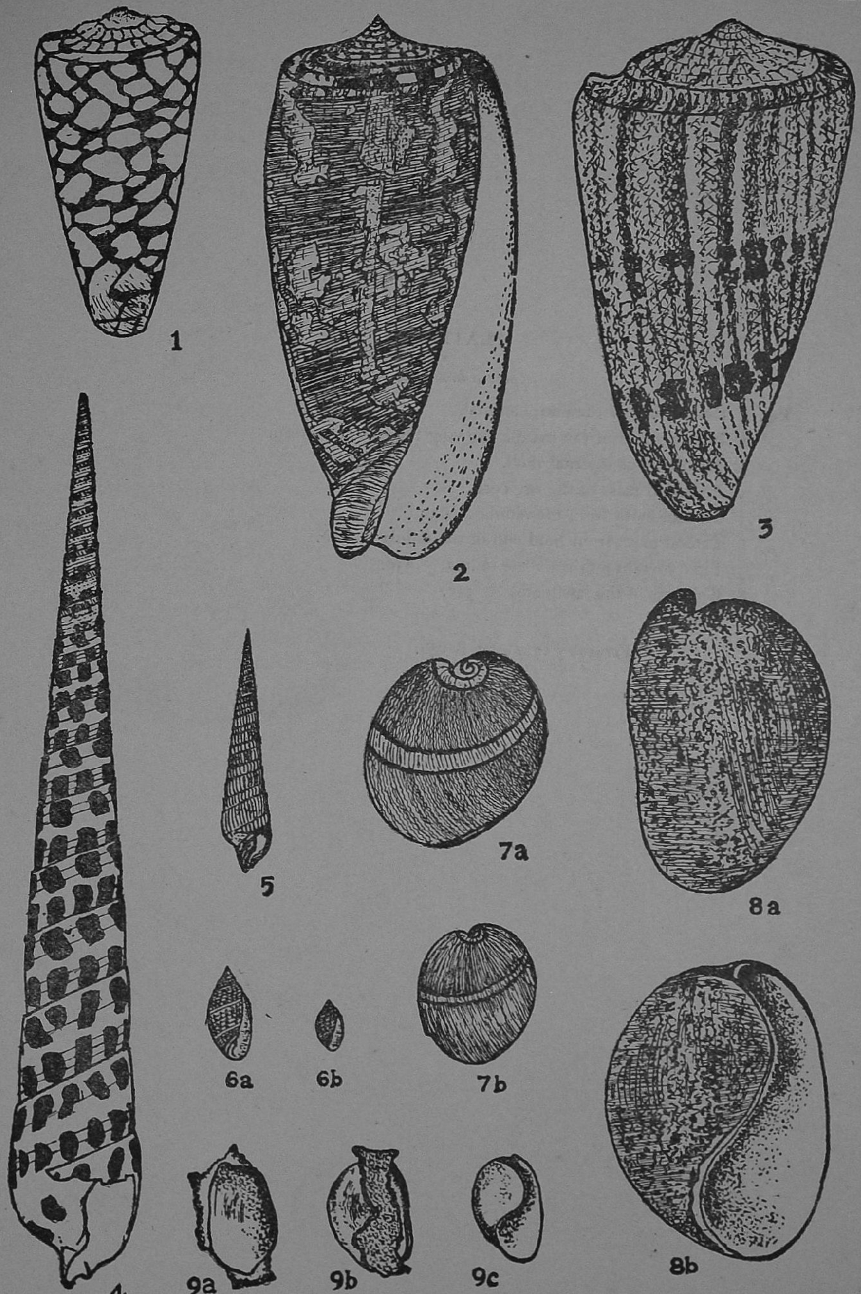
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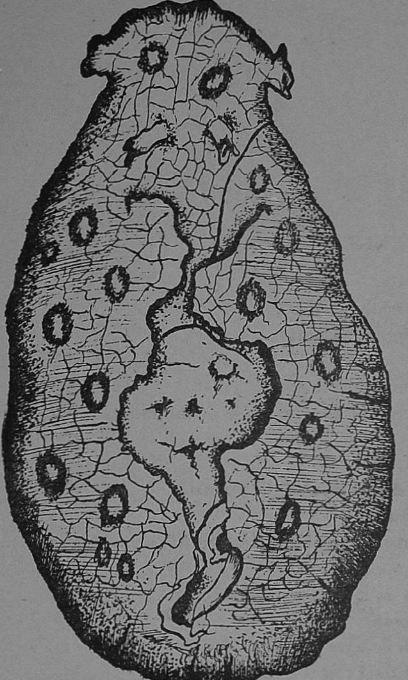
PLATE XXII.

Aplysia benedicti Eliot.

Fig. 1. Dorsal view of the entire animal.
" 2. Inner surface of the mantle showing the colour pattern.
" 3. Membranous internal shell.
" 4. A tangled mass of the egg cord.
" 5. Median tooth from the radula × 350.
" 6. Lateral tooth from hind end of the radula × 350.
" 7. First lateral tooth from the radula × 350.
" 8. Elements of the jaw plates × 350.
" 9. Penis.

(Figures 5 to 9 after Bergh.)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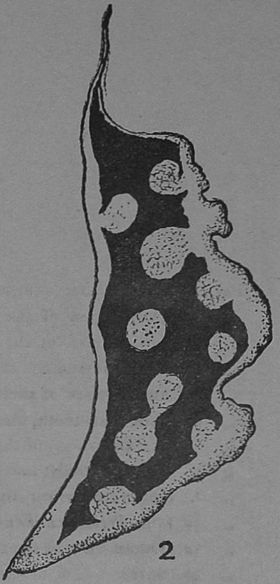
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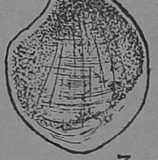
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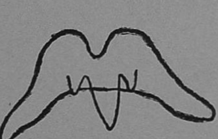
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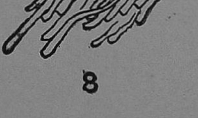
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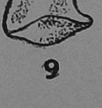
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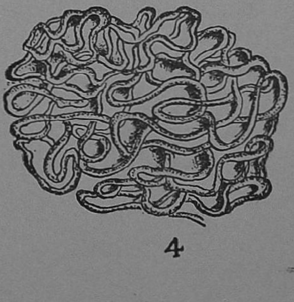
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PLATE XXIII.

Fig. 1*a* to *f*. *Aplysia cornigera* Sowerby.

" 1*a*. Dorsal view of the entire animal, (slightly shrunk).

" 1*b*. Ventral view of the entire animal, (slightly shrunk).

" 1*c*. Profile of shell.

" 1*d*. Ventral view of shell.

" 1*e*. Rachidial tooth, first and second laterals of the right side of the radula × 75, (after Eales).

" 1*f*. Five outermost laterals × 75, (after Eales).

" 2. *Aplysia lineolata* Adams and Reeve : dorsal view of the animal.

" 3*a* to *f*. *Petalifera krusadaiae* O'Donoghue.

" 3*a*. Dorsal view of the type specimen obtained from the Indian Museum, (enlarged).

" 3*b*. Surface view of the rachidial tooth × 450

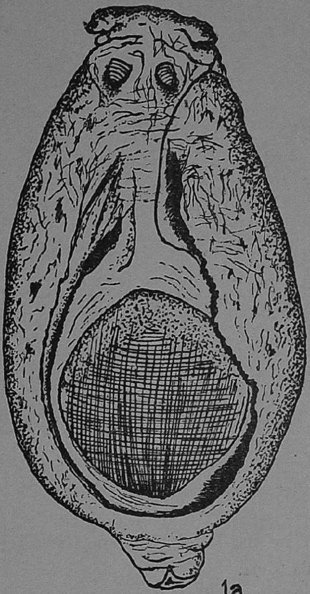
" 3*c*. Surface view of the first pleural tooth as it appears *in situ* × 450.

" 3*d*. Surface view of the twelfth pleural tooth × 450.

" 3*e*. Lateral view of the sixth lateral tooth × 450.

" 3*f*. Surface view of the three outermost lateral teeth × 450.

(Figures 3*b* to *f* after O'Donoghue.)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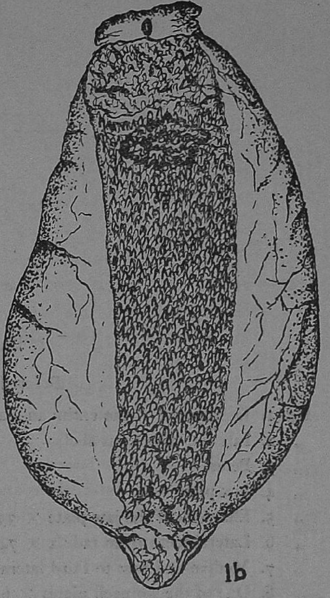
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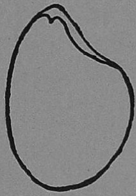
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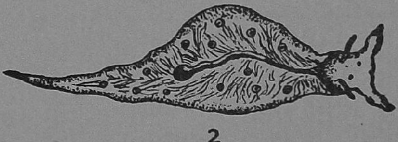
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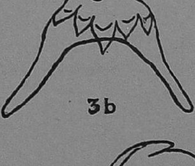
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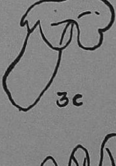
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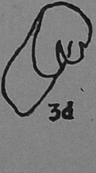
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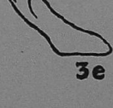
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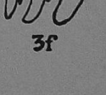
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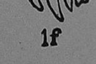
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PLATE XXIV.

Dolabella rumphii Cuvier.

Fig. 1. Dorsal view of the entire animal.
" 2. Internal calcareous shell.
" 3. Penis.
" 4. Jaw plate × 4.
" 5. Elements of the jaw plate × 350.
" 6. Lateral teeth from radula × 74.
" 7. Median and first to third lateral teeth from radula × 74.
" 8. One of the stomach plates × 6.

(Figures 3 to 5, and 8 after Bergh ; 6 and 7 after Farran.)

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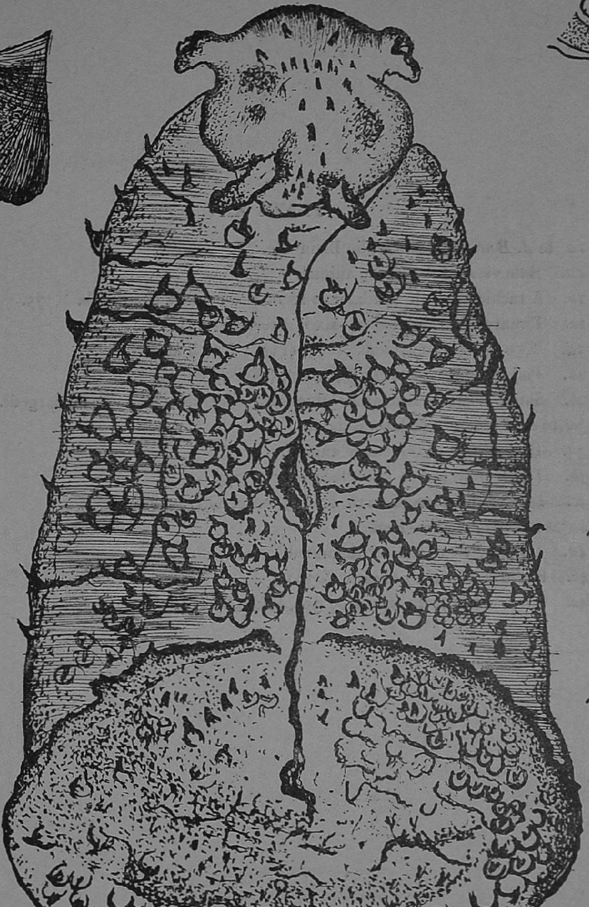

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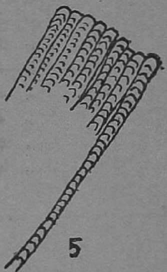

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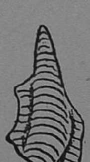

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PLATE XXV.

Fig. 1*a* to *d*. *Bursatella leachii* de Blainville.

„ 1*a*. Side view of the entire animal.

„ 1*b*. A rachidial tooth and laterals from two rows in the radula × 75.

„ 1*c*. Twenty-fifth and twenty-sixth laterals × 75.

„ 1*d*. Two outermost laterals × 75, (Fig. 1 *b* to *d* after Eales).

„ 2*a*. *Polybranchia orientalis* (Kelaart), (slightly enlarged).

„ 2*b*. Single dorsal cerata of *Polybranchia orientalis* (Kelaart), (enlarged).

„ 3*a* to *c*. *Elysia grandifolia* Kelaart.

„ 3*a*. Dorsal view of the entire animal.

„ 3*b*. Tooth from radula in surface view × 235.

„ 3*c*. Two teeth in lateral view × 235, (after O'Donoghue).

„ 4*a* to *c* *Elysia ornata* (Pease).

„ 4*a*. Dorsal view of the entire animal.

„ 4*b*. Radula and radula sheath × 350.

„ 4*c*. Single tooth from radula × 350, (after Bergh).

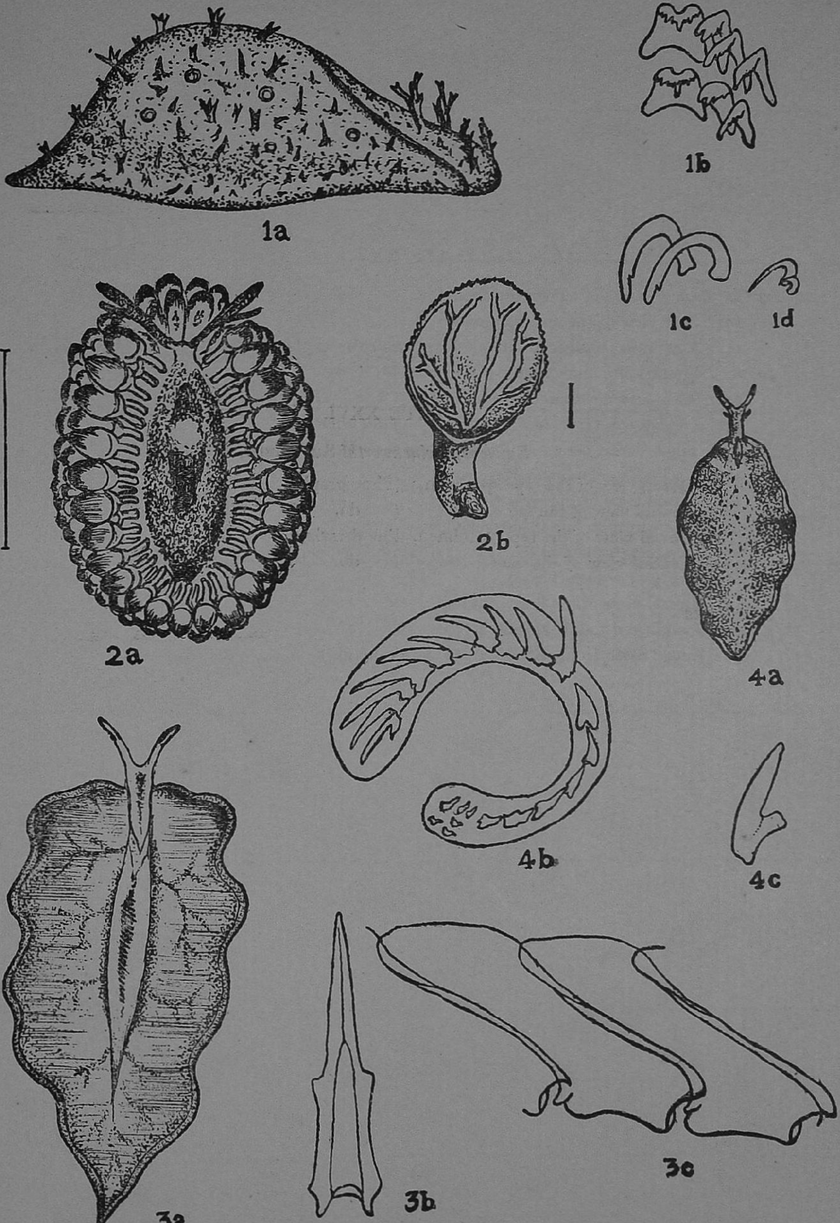
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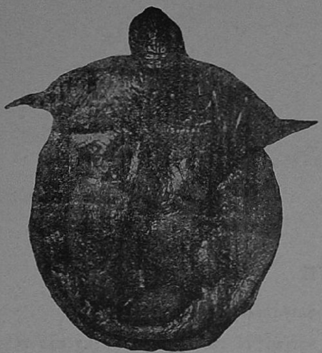
PLATE XXVI.

Euselenops winckworthi Satyamurti.

Fig. 1. Dorsal view of the type specimen, (Photograph).
,, 2. Ventral view of the same, (do.).
,, 3. Dorsal view of the type specimen, (line drawing).
,, 4. Ventral view of the same, (do.).



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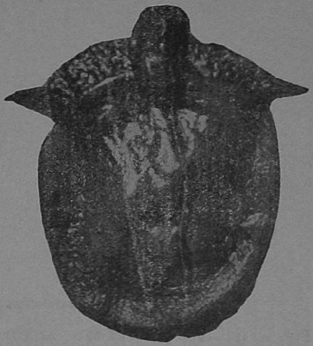

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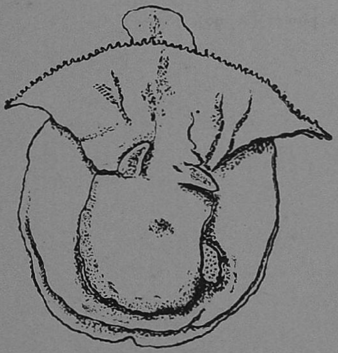

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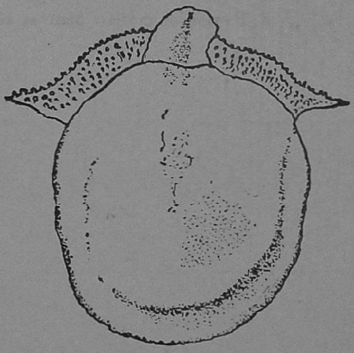

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PLATE XXVII.

Euselenops winckworthi Satyamurti.

Fig. 1. Enlarged view of the pharynx and ventral surface of the velum showing the velar processes × 2.

„ 2. A single velar papilla enlarged × 12.

„ 3. The rhinophore of the left side × 5.

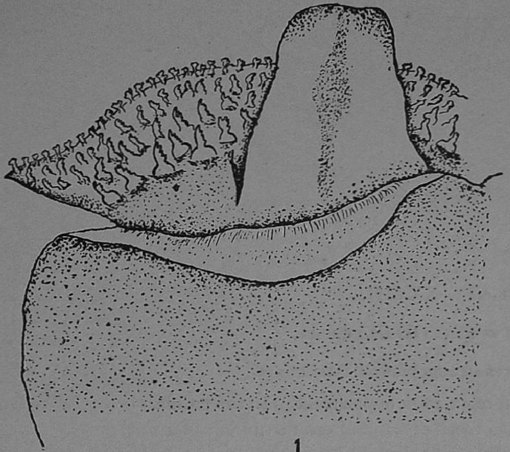
„ 4. The penis × 5.

„ 5. Lateral view of the gill × 4: P.B.S. Opening of the prebranchial sac; Pn. Pinnule; A. Anus; R. Gill rachis. T. tubercles on the rachis.

„ 6. General view of the radula × 4.

„ 7. General view of the jaw plates × 4.

„ 8. Portion of the jaw plate as seen under the low power (× 90).



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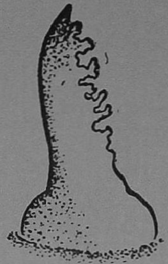

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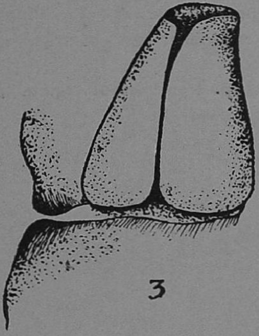

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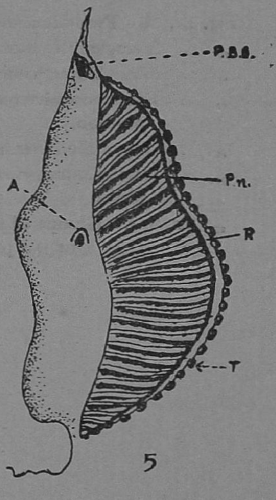

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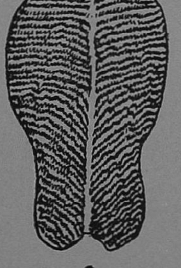

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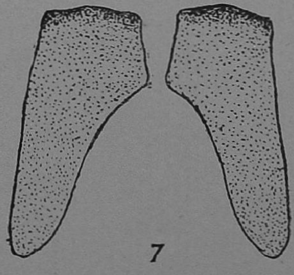

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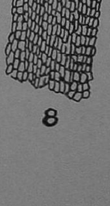

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PLATE XXVIII.

Euselenops winckworthi Satyamurti.

(All figures in this plate × 380.)

Fig. 1*a*, *b*. Two outermost pleural teeth from opposite sides in the radula.

" 2. A single fully formed normal tooth of radula from the middle of a row.

" 3*a* to *c*. Three pleural teeth from near the rachis.

" 4. Four successive pleural teeth as seen with their bases dove-tailed, in their normal position.

" 5. One of the innermost pleurals.

" 6. Narrow, transversely elongate jaw elements at the posterior end of the jaw plates.

" 7*a* to *e*. Groups of jaw elements of regular and irregular shape from various regions of the jaw plates.

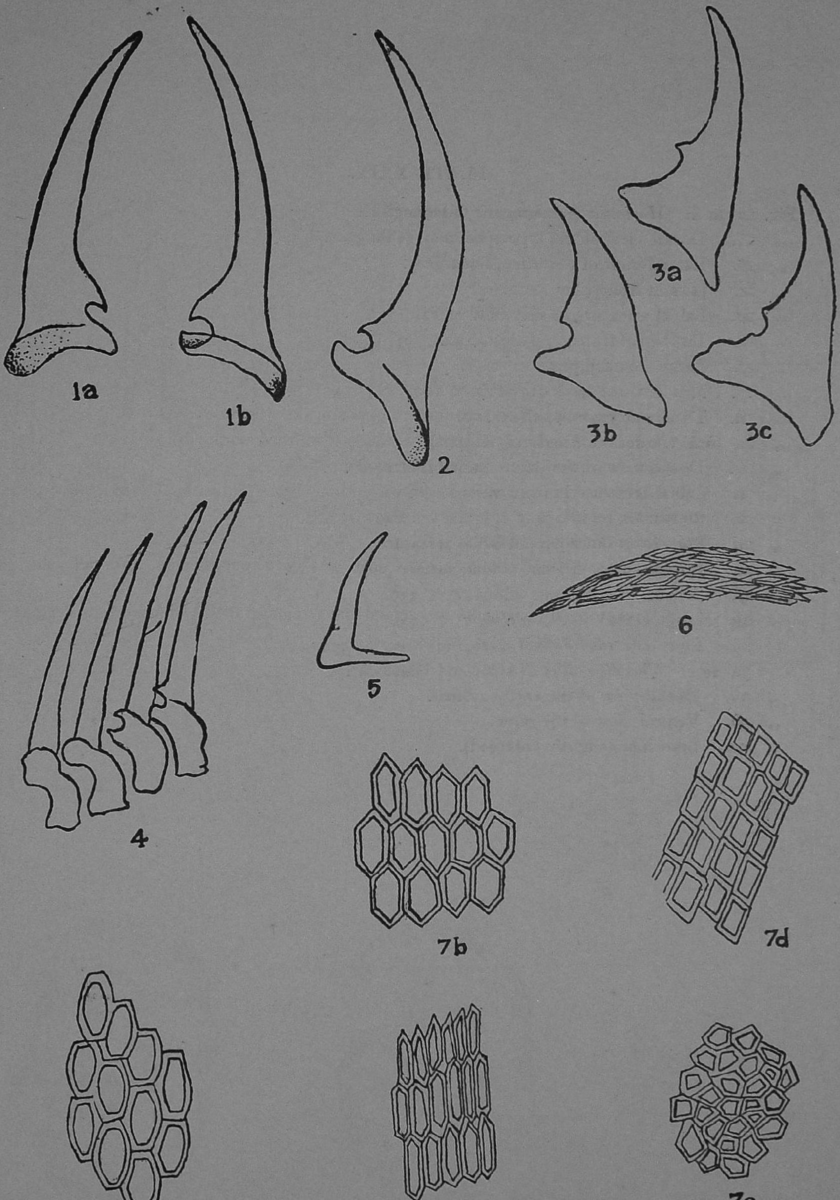
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PLATE XXIX.

Fig. 1*a* to *h*. *Marionia pambanensis* O'Donoghue.
,, 1*a*. Dorsal view of the type specimen, (enlarged).
,, 1*b*. Lateral view of the same, (enlarged).
,, 1*c*. Jaws in front view × 12.
,, 1*d*. Labial armature in side view × 12.
,, 1*e*. Two small stomach plates × 32.
,, 1*f*. Large stomach plate × 32.
,, 1*g*. Middle three teeth of radula × 200.
,, 1*h*. Three outermost teeth × 200.
,, 2*a* to *h*. *Glossodoris humberti* (Kelaart).
,, 2*a*. Dorsal view of the entire animal (enlarged).
,, 2*b*. Labial armature in front view × 16
,, 2*c*. Rods from middle part of labial armature × 720.
,, 2*d*. Rods from inner part of labial armature × 720.
,, 2*e*. Innermost tooth from radula, surface view × 530.
,, 2*f*. Second lateral tooth, side view × 530.
,, 2*g*. Large lateral tooth, side view × 530.
,, 2*h*. Four outermost lateral teeth, side view × 530.
,, 3*a* to *c*. *Thordisa villosa* (Alder and Hancock).
,, 3*a*. Dorsal view of the entire animal.
,, 3*b*. Ventral view of the same.
,, 3*c*. Branchiae (slightly enlarged).

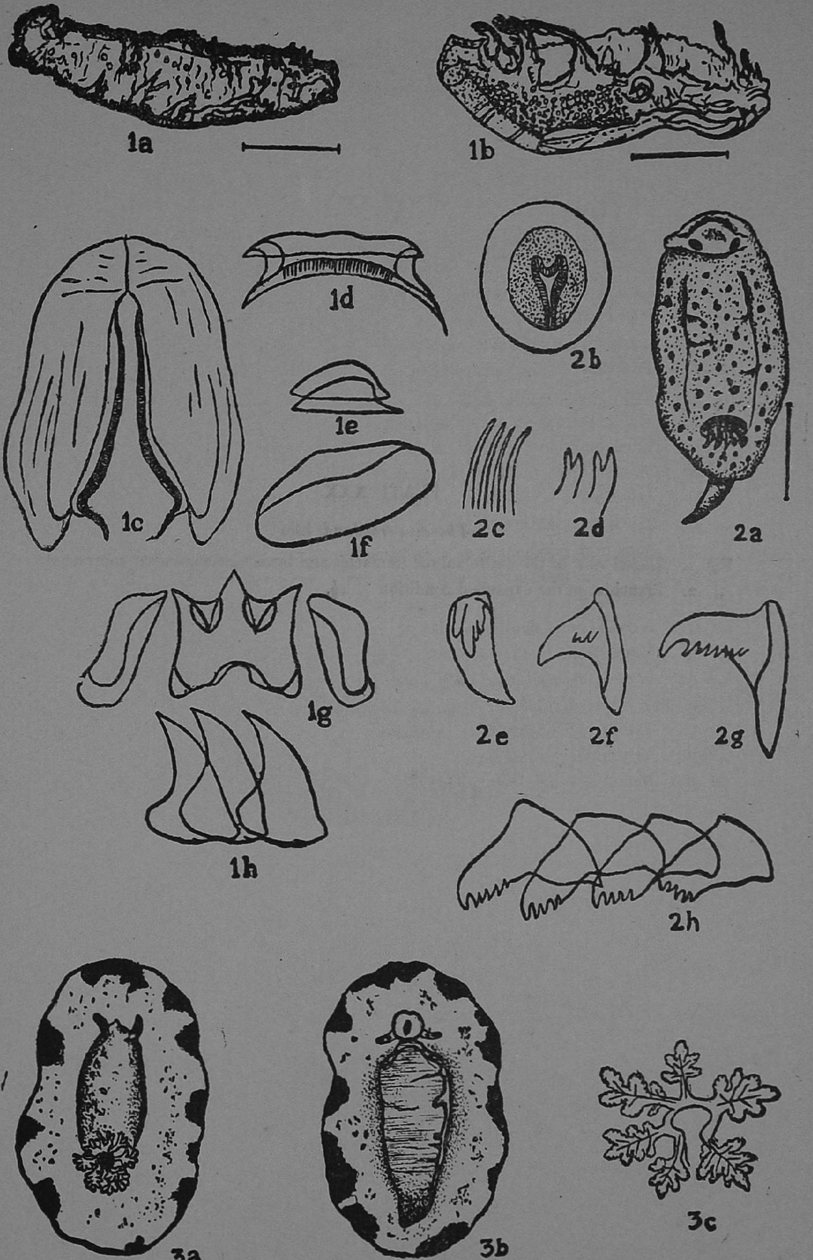
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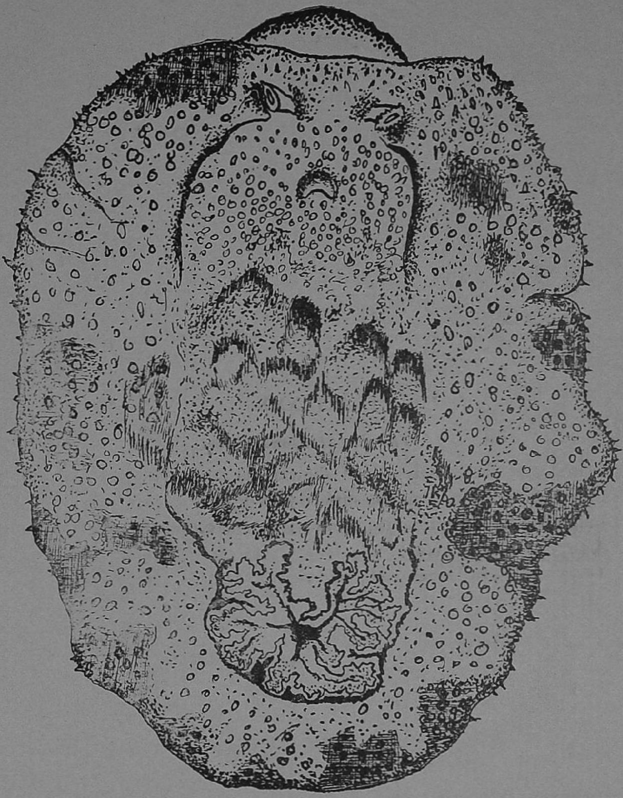
PLATE XXX.

Thordisa crosslandi Eliot.

Fig. 1. Dorsal view of the entire animal (tentacles and branchiae somewhat contracted).

" 2. Branchiae in the expanded condition × $1\frac{1}{2}$.



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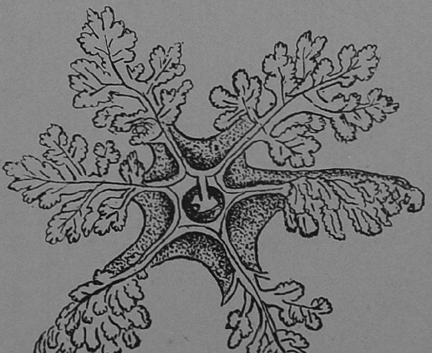

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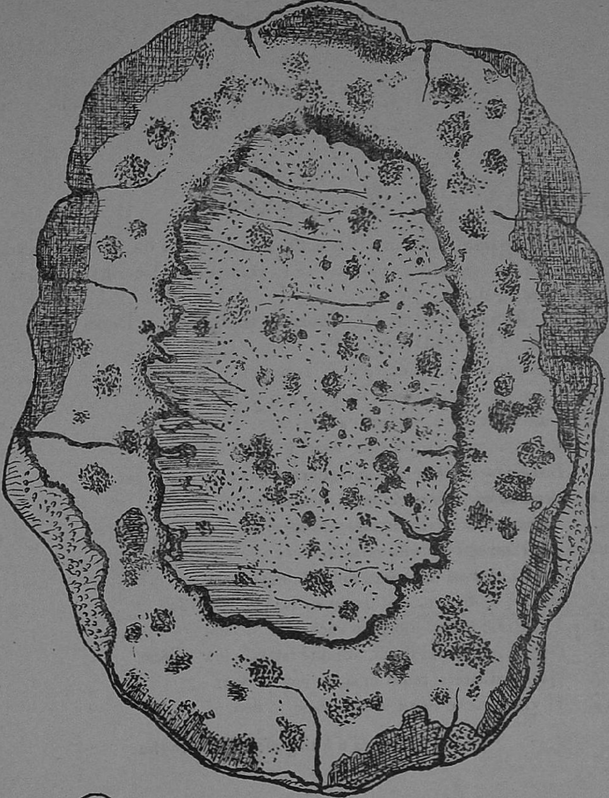
PLATE XXXI.

Thordisa crosslandi Eliot.

Fig. 1. Ventral view of the entire animal, showing the large foot.
" 2. Innermost tooth from radula, surface view × 240.
" 3. Innermost tooth from radula, lateral view × 240.
" 4. A large tooth, side view × 114.
" 5. Three outermost lateral teeth, side view × 240.



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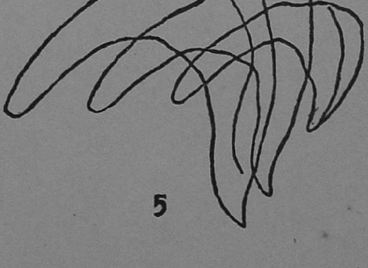

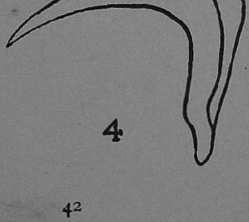

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PLATE XXXII.

Fig. 1. *Trippa tristis* (Alder and Hancock), dorsal view of the animal, (enlarged).

„ 2. *Halgerda apiculata* (Alder and Hancock), dorso-lateral view of the animal, (enlarged).

„ 3*a* to *d*. Radular elements of *Asteronotus madrasensis* O'Donoghue. (After O'Donoghue.)

„ 3*a*. Innermost tooth, side view × 240.

„ 3*b*. Large lateral tooth, side view × 240.

„ 3*c*. Innermost tooth, surface view × 240.

„ 3*d*. Four outermost teeth, side view × 240.

„ 4*a*. *Dendrodoris rubra* (Kelaart), dorso-lateral view.

„ 4*b*. *Dendrodoris rubra* (Kelaart), dorsal view.

„ 5. *Dendrodoris nigra* (Stimpson), dorso-lateral view.

„ 6*a* to *g*. *Pleurophyllidiella paucidentata* O'Donoghue.

„ 6*a*. Dorsal view of the entire animal, (enlarged).

„ 6*b*. Median tooth from radula, in surface view × 800.

„ 6*c*, *d*. The first lateral tooth on each side × 800.

„ 6*e*. The second lateral tooth, oblique lateral view × 800.

„ 6*f*. The third lateral tooth in side view × 800.

„ 6*g*. The last lateral tooth in side view × 800.

(Figures 6 *b* to *g* after O'Donoghue.)

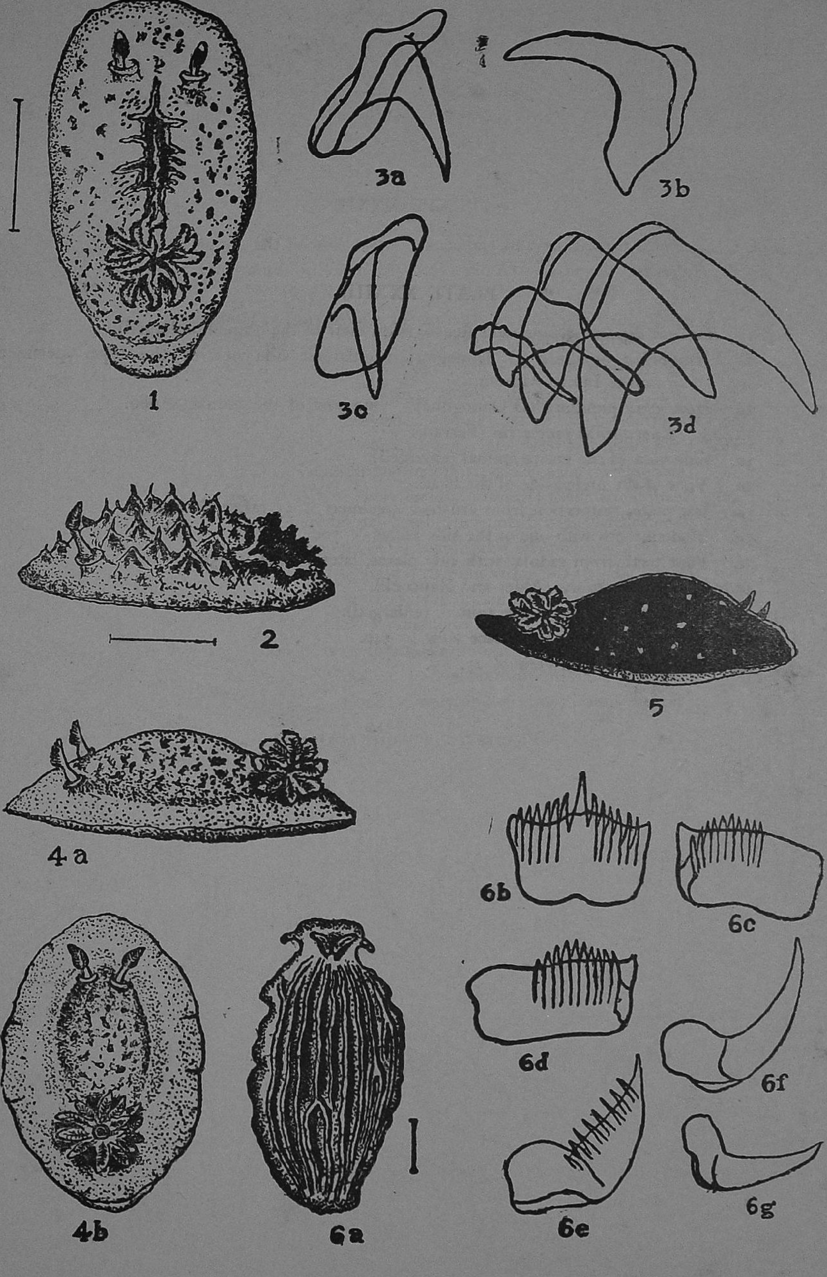
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PLATE XXXIII.

Fig. 1. *Bornella digitata* Adams and Reeve, (side view of the animal, enlarged).

" 2*a*. *Hancockia papillata* (O' Donoghue): enlarged side view of the type specimen from the Indian Museum.

" 2*b*. *Hancockia papillata* (O'Donoghue): One row of the radula × 666.

" 3*a* to *e*. *Eubranchus productus* (Farran).

" 3*a*. Side view of the entire animal (enlarged).

" 3*b*. View of the under side of the head.

" 3*c*. Jaw plate, restoration from crushed specimen × 55 (after Farran).

" 3*d*. Median tooth with one of the side plates × 700.

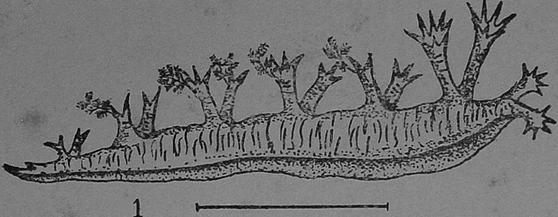
" 3*e*. Four teeth from radula, with side plates, lateral view × 350.

" 4*a* to *c*. *Hervia militaris* (Alder and Hancock).

" 4*a*. Dorsal view of the entire animal, (enlarged).

" 4*b*. Tooth from radula in surface view × 340.

" 4*c*. One jaw in lateral view × 27.



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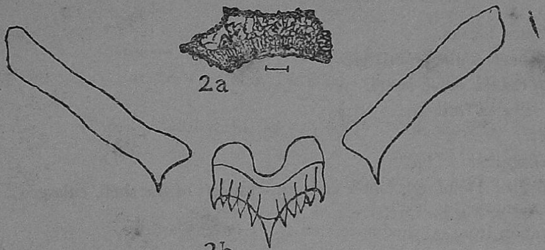

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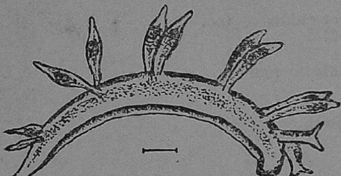

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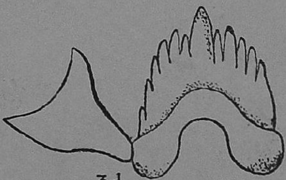

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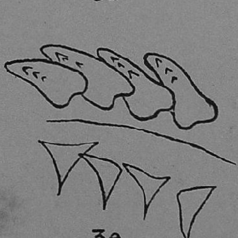

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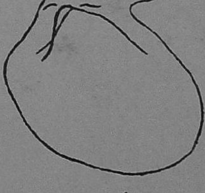

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PLATE XXXIV.

Fig. *1a* to *e*. *Hervia ceylonica* Farran.

„ *1a*. Side view of the entire animal (enlarged).

„ *1b*. Three teeth from radula, dorso-lateral view × 470.

„ *1c*. Tooth from radula, seen from above × 470.

„ *1d*. Jaw plate × 83.

„ *1e*. Cutting edge of jaw plate × 340.

„ *2a*, *b*. *Siphonaria stellata* (Helbling), (outer and inner aspects of the shell, enlarged).

„ *3a* to *f*. *Onchidium verruculatum* Cuvier.

„ *3a*. Dorsal view of the entire animal.

„ *3b*. Ventral view of the same, showing the foot.

„ *3c*. Hooks from glans penis × 116.

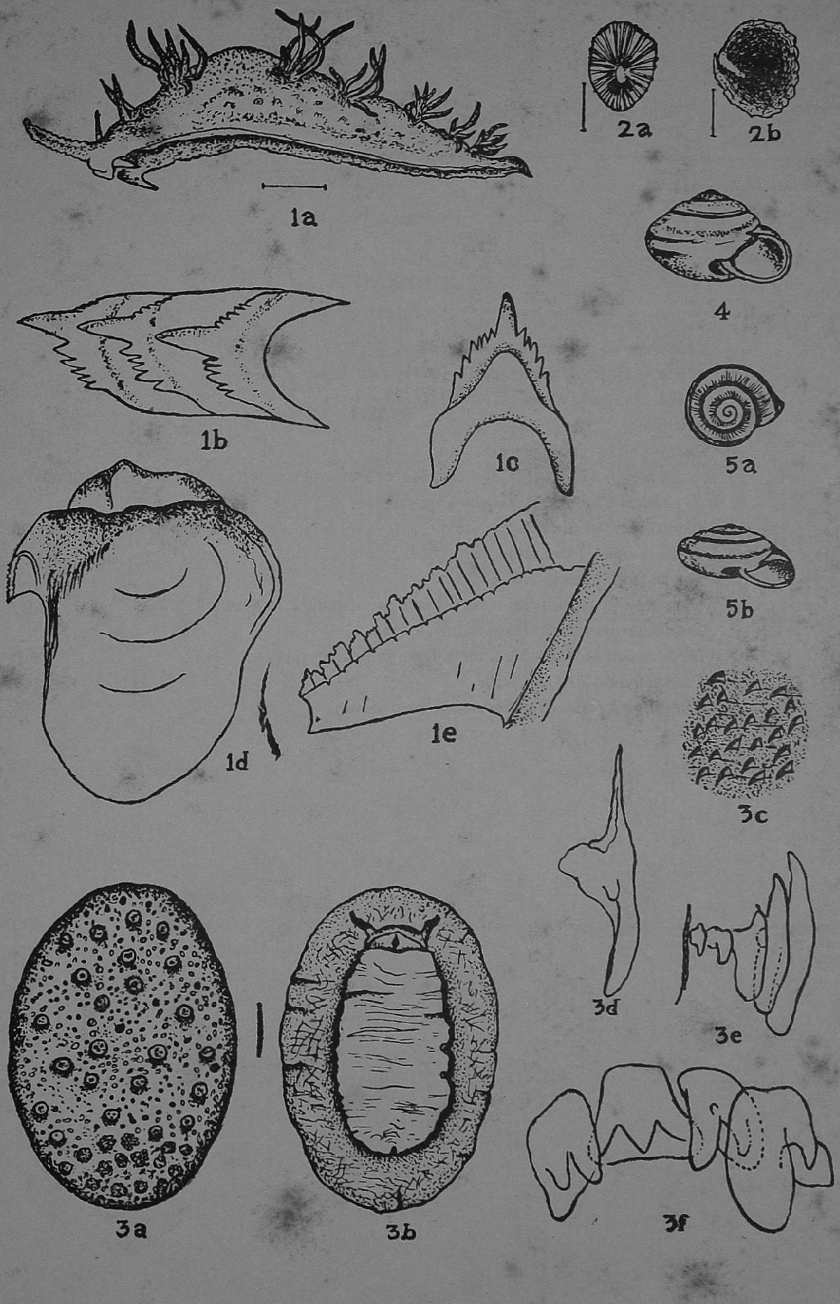
„ *3d*. Side view of tooth from near the margin of radula × 300.

„ *3e*. Five outermost teeth from radula × 310.

„ *3f*. Median and second lateral teeth from radula × 300.

„ 4. *Planispira vittata* (Muller).

„ *5a*, *b*. *Planispira fallaciosa* (Férussac), (two views).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